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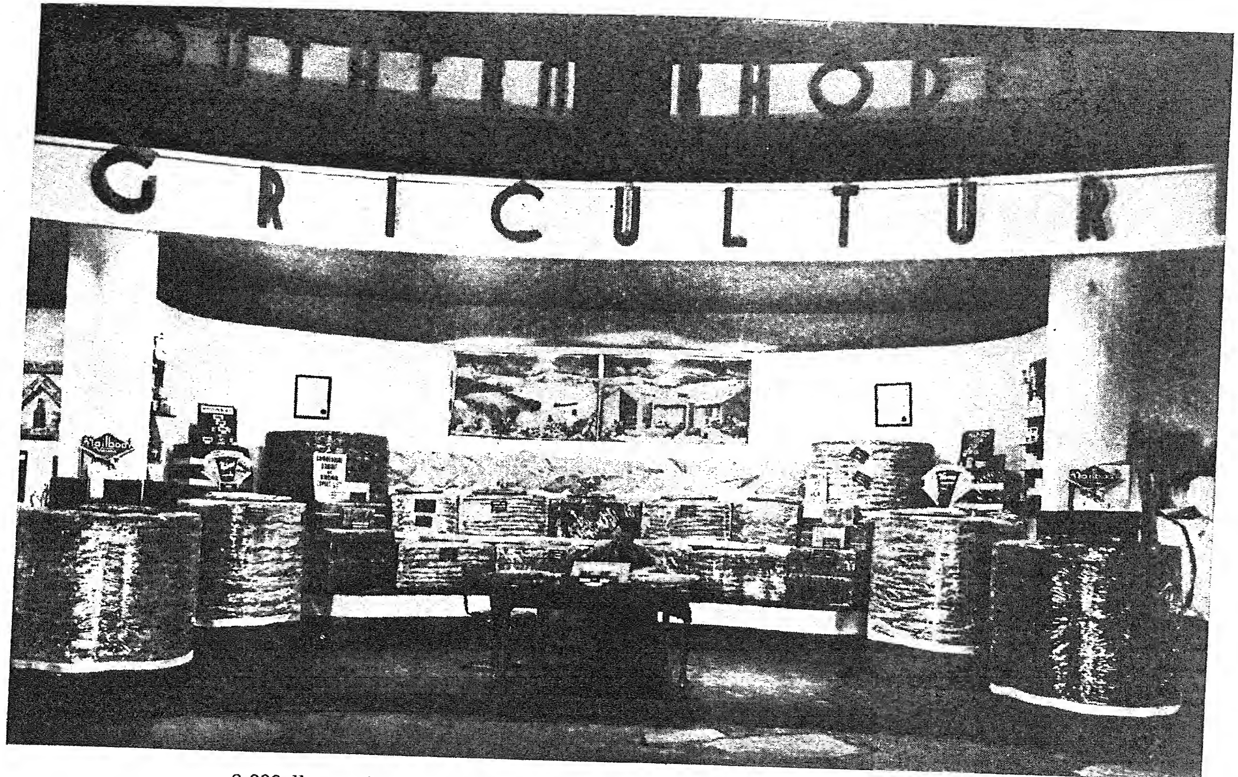

8,000 lbs. weight of Southern Rhodesian Tobacco Leaf at the Empire Exhibition, Johannesburg.

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Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

We wish all our readers and advertisers
A Happy and Prosperous New Year.

Slight Change in Form.—It will be noticed that beginning with this issue a slight change has been made in the form of this Journal. The binding margin has been increased and each number will be punched so as to facilitate keeping the copies together. As each volume is complete a cheap cover can be obtained so that a permanent file can be kept at little additional cost.

Agricultural Research in 1935.—For the past 11 years the Royal Agricultural Society of England has issued annual summaries of world agricultural research, as carried on in its

leading branches, prepared under the direction of the research committee of the society. The publication, originally issued under the title of *Agricultural Research*, is now known as *The Farmer's Guide to Agricultural Research*, for this describes the main purpose with which the society undertook the work, namely, the laudable one of spreading the lessons of research among those to whom they are likely to be of greatest use by giving the farmer information on the results of the year's work of the experimental stations in a summarised and simple form. As last year, *The Farmer's Guide* forms a section of the society's *Journal*, so that it may be in the hands of every member, but a number of copies are bound separately for limited distribution. Its seven sections deal with crops and plant breeding; diseases of animals; farm implements and machinery; farm economics; dairy farming and dairy work; feeding of live-stock; and soils and fertilisers.

Official Egg Laying Test.—When the 1936-37 Egg Laying Test concludes on January 30th it will be the last held under the present system of calculating the positions by the *total weight of 2 oz. eggs* laid.

This Egg Laying Test has now taken place for 17 consetive years and has fulfilled a definite want in the industry. This is amply indicated by the support it has always received from the stud breeders of this Colony and also from the Union of South Africa and Northern Rhodesia.

In making the change referred to in the calculation of positions a step forward is indicated, for the old method was deliberately chosen 17 years ago in order to foster the production of larger eggs. This undoubtedly encouraged the consequent breeding of birds possessing this desirable character in their hereditary make up. At that time the size of eggs laid by most birds in this Colony was poor. To-day, largely owing to the efforts of our own breeders, influenced by the Egg Laying Test, the size of eggs has improved to such an extent that it is now considered quite equal to all market requirements either here or overseas.

The South African Poultry Association provide certificates and Blue Ribbons for birds that qualify on the Southern Rhodesia Egg Laying Test, and their awards are presented

on the basis of *number of 2 oz. eggs laid* instead of total weight. This is the practice at all Union Tests, and the Southern Rhodesia Egg Laying Test will largely fall into line with these in the future tests commencing with the next test beginning on 1st March, 1937. Circulars have been sent to breeders giving full particulars and all agree that the change is desirable.

It is anticipated that this popular test will still retain the staunch support of all breeders in the Colony. Copies of the new rules may be obtained by any intending competitors by applying to the Chief Poultry Officer, Department of Agriculture, P.O. Box 387, Salisbury.

Fowl Manure a Valuable Fertiliser.- The Summer number of the "*S.A.G.*" maintains the high standard of excellence for which this publication is noted, and contains material to interest all lovers of gardens, including flowers and birds. The following note indicates the practical nature of the gardening advice it regularly provides.

Poultry manure is a very valuable by-product of the poultry-run but one that is largely neglected by gardeners and farmers. Of all animal manures it is the richest in plant food and it is well worth taking some trouble to preserve it, so as to minimise loss.

The night droppings of 1,000 birds may amount in a year to as much as 20 tons, a fact which makes the value of this by-product of the poultry yard at once apparent.

Poultry manure is mainly a nitrogenous manure. As our soils are normally lacking in phosphate, it is necessary to provide liberally for that item of plant-food in any system of manuring. The poultry manure can be regarded as supplying nitrogen and humus, but most of the phosphate required should be made up by using superphosphate in the amount usually applied for the crop concerned. A convenient plan is to sprinkle superphosphate on the dropping boards or the floors of the poultry houses. If for every 100 birds, 1 lb. to 1½ lb. of super are used per day on the dropping boards the

proportions of manure and super given in the mixture in the following paragraph will be maintained. This helps to dry the manure, reduce loss of ammonia by fermentation and aids in control of the fly pest.

The manure as collected is too damp for convenient handling and requires to be dried if it is to be stored before use. It is convenient to mix it with some absorbent material such as fine soil, sawdust or (what is best of all) sifted kraal manure. A useful general formula is: Poultry manure 8 parts, sifted kraal manure 4 parts and super 2 parts. The mixture is then spread out to dry and raked over occasionally. A convenient method of handling the manure is to spread the mixture on wooden trays which can be carried under cover in case of rain.

If the soil is deficient in potash as in the case of sandy or old lands the addition of ½ a part of muriate of potash is needed to make the fertiliser a perfectly balanced manure.

Poultry manure can also be thrown on the usual farm manure heap or mixed with waste litter or any other vegetable refuse, put into a pit, or made into a compost heap and allowed to rot before being used. If allowed to rot without any addition of such refuse it will heat up rapidly and its value will be reduced owing to the loss of nitrogen in the form of ammonia.

Care should be exercised in using poultry manure as it is apt to burn plants owing to its richness and to the soluble nature of the plant food present in it. Plants should be well-watered to minimise this risk. It is best suited for garden work or other intensive systems of cropping. It should not come into direct contact with the plant but should be well mixed with the soil, and preferably a week or two before planting.

For garden work one or two tons of the fresh manure or of the mixture mentioned above are used per acre, *i.e.*, rather less than ½ to 1 lb. per square yard. If the manure is used alone, superphosphate must also be applied at the rate of about 2 oz. per square yard (600 lb. per acre).

Liquid manure can be made by soaking 5 lb. of fresh manure in an old bag in 10 gallons of water for two or three days, stirring the liquid at intervals. This liquid should be diluted for use with at least an equal volume of water and the plants well watered with clean water after using the liquid manure. If the soil is dry, a thorough watering before using the liquid manure is also advisable.

Moisture Requirements for Good Silage.—The moisture content or succulence of the crop plays an important part in the quality of the silage. In experiments conducted on the Central Experimental Farm at Ottawa the production of good or bad silage can usually be traced to the amount of moisture contained in the ensiled crop. Too dry material invariably results in mouldy silage. The presence of too high a moisture content produces sour, rotten silage. For best results different crops require different moisture contents. In general, however, a moisture content between 65 and 75 per cent. will produce good silage.

Amos and Woodman, in Bulletin No. 37 of the British Ministry of Agriculture, divide silages into five distinct types based on the temperature reached in the silage process, the temperature being controlled quite largely by the moisture content of the silage. These five types embrace:—

1. Sweet, dark brown silage produced from a comparatively dry crop where conditions are such that fermentation is facilitated by the presence of sufficient air so that the temperature rises above 113° F. This makes good silage which is relished by cattle but is produced by excessive fermentation with a considerable loss in digestible nutrients. For this reason it is not generally recommended.

2. Acid, light brown or yellow silage, a good silage made from material with a dry matter content of 25 to 30 per cent. which allows for temperatures of from 86° to 104° F. with a pleasant acid smell. It is the type of silage which is recommended.

3. Green fruity silage is made from immature succulent material high in moisture and is a silage in which the temperature seldom goes above 86° F. It is characterised by a

fresh fruity odour and green to olive green colour. Considerable loss occurs with this silage due to the draining away of the juices. It makes a palatable silage which is readily eaten by cattle but is more difficult to make than other types and is not generally recommended.

4. Sour silage has a dark brown or olive brown colour with a pungent and very unpleasant smell due largely to the presence of butyric acid. It is made from very immature and succulent crops or it may be found in the bottom of the silo where moisture accumulates. It is also associated with oats, peas and vetch silage where the growing crop has lodged badly and become partially rotten. This is a very poor type of silage.

5. Musty silage usually occurs following the ensiling of crops which are too dry thereby allowing the presence of an excessive amount of air in which moulds develop. It is found, also, on the top of silos, or near cracks in stave silos where air has ready access. It occurs sometimes in patches throughout the silage mass.

Considerable judgment is necessary to ensile crops at the proper stage of maturity and succulence in order to make the highest quality of silage and to avoid, in some cases, instances of complete failure where the silage is unfit for feed.

Free Issues to Check Soil Erosion.—In order to assist in the control of soil erosion the Department of Agriculture has arranged to make available to farmers free issues of small quantities of crowns of Kudzu Vine, Spineless Cactus, and a number of varieties of creeping grasses. Such free issues will only be made on the assurance that they will be utilised for planting in places where the wash may cause erosion, *e.g.*, where contour ridges or storm water drains discharge. The establishment of these crops will promote rapid silting and check further erosion.

Requests for planting material of the above crops should be addressed to the Agriculturist, Department of Agriculture, Salisbury.

Advice on Soil Conservation.—Farmers requiring advice on matters relating to soil conservation, irrigation and water conservation schemes are requested to send in their applications for visits, as soon as possible, to the Chief Engineer, Irrigation Division, P.O. Box 387, Salisbury, or, if in Matabeleland, to the Irrigation Engineer (Matabeleland), P.O. Box 566, Bulawayo.

Applications should state the name of the farm, the type of work and approximate acreage or estimated time that the engineer will be occupied on the work, and the most suitable month for the visit. While it is not always possible to arrange a visit during the month requested, every endeavour will be made to do so.

There is no charge for this advice if it is carried out during the course of a tour, but farmers are asked to refrain from asking an engineer to visit their farms if he is touring in any district and the farmers concerned have not previously applied for a visit to either of the above addresses. The reason for this request is that engineers make out their itineraries and notify the applicants of the date of the proposed visit, before leaving headquarters, and any unforeseen delays mean that these dates cannot be adhered to.

The co-operation of farmers is, therefore, requested in order that disappointments may as far as possible be avoided.

SALES,

Agricultural Experiment Station, Salisbury.

Spineless Cactus Slabs (blades) Algerian and Moscatel varieties, per 100 Slabs 5/- delivered at the Salisbury Experiment Station, or 7/6 delivered free by rail to any station or siding in Southern Rhodesia. For amounts of 500 slabs or more a reduction of 2/6 per 100 will be made.

Kudzu Vine Crowns, per 100 Crowns 15/- delivered at Salisbury Experiment Station, or 25 Crowns 7/6; 50 Crowns 15/- and 100 Crowns, 22/6, delivered free by rail to any station or siding in Southern Rhodesia. Delivery during January for dry land. Owing to pressure of other operations it is not possible to deliver Kudzu Crowns and Cactus Slabs during December.

Woolly Finger Grass, 10/- per bag of roots, delivered free by rail to any siding or station in Southern Rhodesia; supplies limited. Available in January and February.

Swamp Couch Grass, 5/- per bag of roots, delivered free by rail to any siding or station in Southern Rhodesia. Available in January and February.

Sweet Potato Cuttings, 6/- per bag, delivered free by rail to any siding or station in Southern Rhodesia. The following varieties will be available in January. Calabash Leaf, Early Butter, Linslade, Red Nancemond, Yellow Jersey.

The prices quoted do not include charges for road motor transport. Cheques should be made payable to the Department of Agriculture, *and preliminary enquiries and subsequent orders* should be addressed to the Agriculturist, Department of Agriculture, Salisbury. (Dec.-Jan.)

Export of Frozen Porkers and Baconers.

FOURTH CONSIGNMENT TO SMITHFIELD.

By Division of Animal Husbandry.

The fourth experimental consignment of frozen porkers and baconers left Cape Town per s.s. Arundel Castle on August 21st and arrived at Smithfield during the first fortnight in September.

The shipment consisted of 53 porkers and twelve baconers. These were reported on in great detail by Messrs. George Kean & Co., Ltd., Colonel T. Dunlop Young, H. Wright, The Imperial Cold Storage & Supply Co., Ltd., Messrs. H. R. Davidson and J. B. Swain.

PORKERS.

It will be recalled that the report received on the previous shipment(1) indicated that the carcases were rather deficient in lean meat and too fat.

To overcome this it was suggested that rations comparatively high in protein be fed, that the pigs be forced before and after weaning on these rations and, if necessary, they be allowed to go slowly towards the end of the feeding period so as not to get too fat.

To get information on these points an experiment was carried out in co-operation with Mr. A. L. Millar, of Estes Park, Salisbury.

Pigs Used.—All the pigs used were the progeny of a good Large White boar (bred by the Rhodes Matopo Estate) mated to average quality Large Black sows which were half sisters.

The litters were all dropped within three days of each other and the pigs were weaned at an average age of $8\frac{1}{2}$ weeks, when the average weaning weight was 23 lbs.

The fact that the sows were rather young and these were their first litters probably accounted to some extent for the rather low weaning weights. Further, while nursing their litters the sows were fed an ordinary farm ration of maize

(1) Published in Rhodesia Agricultural Journal of April, 1936, and issued as Bulletin No. 985.

and separated milk without any creep feeding, as it was not known at that time that the weaners would be used for export.

Experimental Groups.—After weaning, the pigs were divided into the following four groups which were uniform in regard to age, weight and breeding. It was specially arranged that the progeny from the different sows were distributed as evenly as possible among the four groups.

Group 1.—High protein—forced feeding.
Group 2.—High protein—limited feeding.
Group 3.—Normal protein—forced feeding.
Group 4.—Normal protein—limited feeding.

Rations.—The two rations used were made up as follows—

High Protein ...	70 lbs. maize meal.
	20 lbs. ground cowpeas.
	10 lbs. meat and blood meal (equal parts).
	1 lb. salt.
Normal Protein ...	70 lbs. maize meal.
	20 lbs. ground cowpeas.
	5 lbs. meat and blood meal (equal parts).
	1 lb. salt.

Feeding.—The pigs were sty-fed throughout. Sliced pumpkins were fed to all groups to supply succulence and daily a small quantity of cowpea hay was fed on the ground and the leaves picked out by the pigs.

To assist the young pigs over the weaning and as ground cowpeas were not immediately available, a small amount of wheat bran and 3 lbs. of separated milk per pig per day were fed for the first week.

All the pigs were fed the high protein ration from weaning until the groups reached an average liveweight of 45 lbs. per pig. From this weight the "normal" protein groups were fed the reduced amount of protein until marketed.

At an average liveweight of 60 lbs. one group (Group 2) on high protein, and one group (Group 4) on normal protein were reduced to a limited plane of feeding until marketed. The other two groups were forced until marketed. Forcing consisted of giving the pigs all the grain they would clean up in three feeds per day. Limited feeding consisted of approxi-

mately two-thirds of the daily ration of the forced groups. The limited fed groups received their feed twice and not three times daily.

Despatch, Slaughter, Dressing, Etc.—The pigs were despatched from Passaford Siding to the works of the Rhodesian Export & Cold Storage Company, Ltd., Bulawayo, in weekly consignments and varied in weight at the time of despatch from 100 to 115 lbs.

Individual weights were taken on the farm just before they left for the station. On arrival at the export works, Bulawayo, they were all ear-tagged and weighed. After a rest, without food, for at least 12 to 24 hours they were slaughtered, dressed and weighed again. These weights are referred to later as the *hot* dressed weights. From then on they were frozen until despatched for shipment to Cape Town. Individual weights were again taken just before the carcasses were loaded into the refrigerator trucks at Bulawayo. These were the *cold* dressed weights or *export* weights.

Table I. gives particulars of the rates of gain, dressing percentages, etc., of the four groups.

TABLE I.

GROUP.	1	2	3	4
Ration and Plane of Intake.	High Protein Forced feeding.	High Protein Limited feeding after 60 lbs. live weight.	Normal Protein Forced feeding.	Normal Protein Limited feeding after 60 lbs. live weight.
Growth Data.				
Average weight at commencement of experiment (lbs.)...	23	23	23	23
Average farm weight at conclusion (lbs.)	110	106	109	110
Average gain in weight (lbs.)	87	83	86	87
Average age at commencement of experiment (days)	60	60	60	60
Average age at marketing (days)...	131	138	134	147
Average number of days in experiment	71	78	74	87
Average daily gain in weight (lbs.)...	1.22	1.06	1.16	1.00

TABLE I.—(*Continued.*)

GROUP.	1	2	3	4
Ration and Plane of Intake.	High Protein Forced feeding.	High Protein Limited feeding after 60 lbs. live weight.	Normal Protein Forced feeding.	Normal Protein Limited feeding after 60 lbs. live weight.
Shrinkage, etc.				
Average live weight at Bulawayo (lbs.)...	98	95	99	99
Average loss in weight Estes Park to Bulawayo (lbs.)... ...	12	11	10	11
Average % shrinkage in transit	10.9	10.4	9.2	10.0
Average hot dead weight (lbs.)	79.3	75.7	79.7	79.4
Average cold dead weight (lbs.)	78.0	74.0	79.0	77.3
Average loss in weight hot weight to cold weight (lbs.)	1.3	1.7	0.7	2.1
Average % loss in weight hot weight to cold weight (%)...	1.6	2.2	0.9	2.6
Average loss in weight farm weight to cold dead weight (lbs.)...	32	32	30	33
Average loss in weight factory live weight to cold dead weight (lbs.)	20	21	20	22
Average dressing % factory live weight to cold dressed weight (%)	79.6	77.9	79.8	78.1

It will be noticed that the average weights and ages of the four groups of pigs were the same at the commencement of the experiment. There was also very little difference between the final marketing weights—not sufficient any way to have affected the quality of the carcases.

The average rate of growth varied quite considerably and requires further discussion.

Effect of Level of Protein Feeding and Level of Feed Intake on Rate of Growth.—As regards the effect of the "high" protein ration (Groups 1 and 2) as compared with the "normal" protein ration (Groups 3 and 4) it will be noticed that under both "forced" and "limited" feeding conditions the high protein groups made slightly more rapid growth and matured on the average from 3 to 9 days earlier than the corresponding low protein groups.

As regards the effect of "forced" and "limited" feeding it is clear that on both the "high" and "normal" protein rations the "forced" fed pigs (Groups 1 and 3) did better than the "limited" fed ones (Groups 2 and 4). On the average groups 1 and 3 reached the correct degree of finish and weight 7 and 13 days earlier than groups 2 and 4 respectively and also made higher average daily gains.

Comparing the effect of the increased protein intake with the increased feed intake (forced feeding) it appears that the forced feeding was more effective than the high protein intake for increasing the rate of maturity of the pigs.

But what is shown very definitely by this experiment is that *forcing* young pigs on a *high protein* ration (Group 1) expedites the maturity of porkers by nearly three weeks and increases the daily rate of gain by about .25 lbs. as compared with feeding them slowly on a low protein ration (Group 4).

Under "Shrinkage, etc.," figures of general interest to farmers appear. As the differences between the different groups are small and not significant a detailed discussion is unnecessary.

Shrinkage in Transit.—The average loss in weight in transit between Mr. Millar's farm, Estes Park, near Passaford Siding, and the Cold Storage, Bulawayo, was about 11 lbs., or 10% per pig. It actually varied between 9 and 14 lbs. per pig.

Shrinkage Hot Dead Weight to Cold Dead Weight.—This varied from .7 lbs. (.9%) to 2.1 lbs. (2.6%) per pig, with an average loss of approximately 2%.

Shrinkage between Live and Dead Weight.—It will be seen that the average loss in weight between the average live-weight of the pigs on the farm prior to despatch and their cold dressed, *i.e.*, export weights, was approximately 32 lbs. per pig and the loss between factory liveweight and export weight approximately 21 lbs. per pig.

Dressing Percentage.—The dressing percentage of the pigs, worked on the basis of factory live weights to cold dressed weights, averaged approximately 79%.

REPORT ON THE GENERAL SUITABILITY OF THE PORKERS.

The "trade" considered this consignment by far the best so far sent, and although detailed examination showed them as being a bit short and overfat for the amount of lean developed, it was the general opinion that pigs of the type and quality of these would find a ready sale in the United Kingdom.

PRICES REALISED.

The porkers sold at an average of 5.86d. per lb. dead weight. Preparation and export charges amounted to approximately 2d. per lb. The nett return at Bulawayo was, therefore, 3.86d. per lb. dead weight, or 3.1d. per lb. liveweight.

DETAILED CARCASE REPORTS.

Messrs. H. R. Davidson and J. B. Swain examined the carcases in great detail before and after they were cut up. In Table II. are given the average data for the four groups of the measurements taken and observations made by them on the cut up carcases.

Figures 1, 2, 3 and 4 give excellent photographs of the four groups of carcases before and after they were cut up.

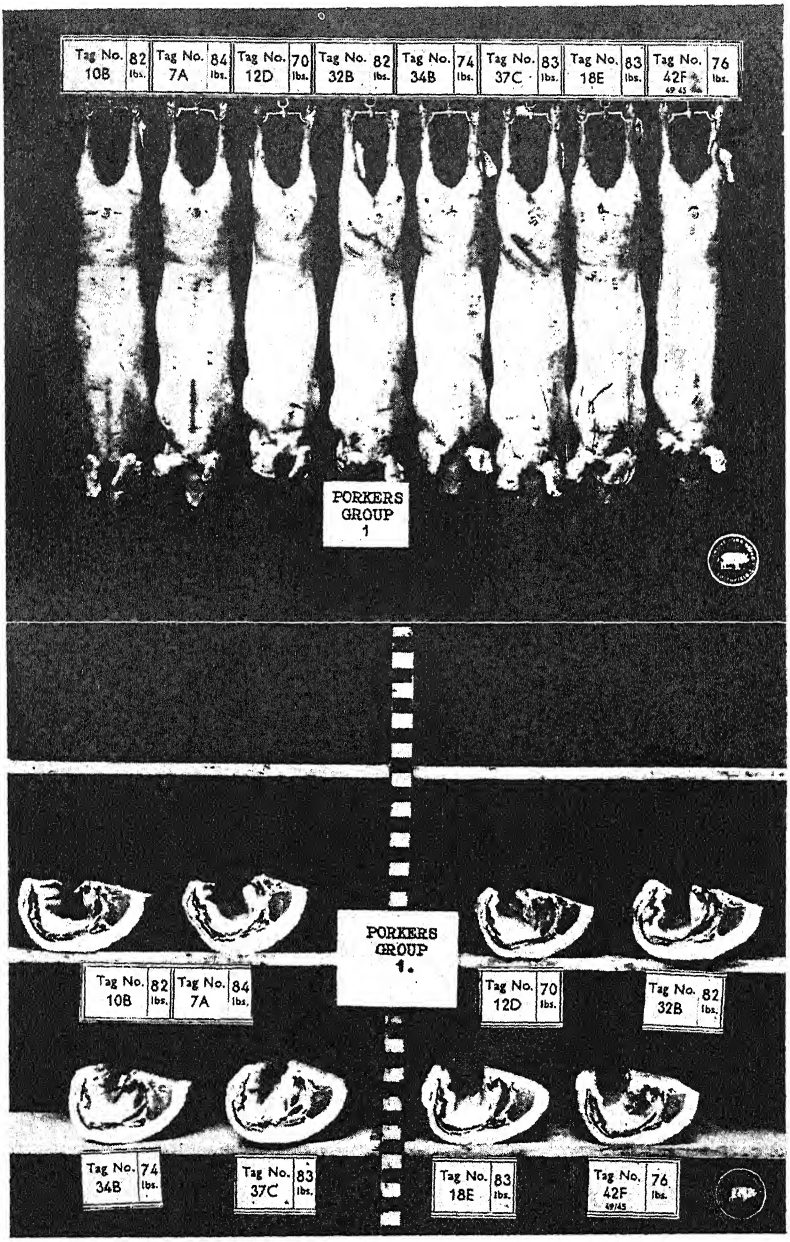

Figure 1.—Group 1 Porkers. Note the bruises on some of the carcases.

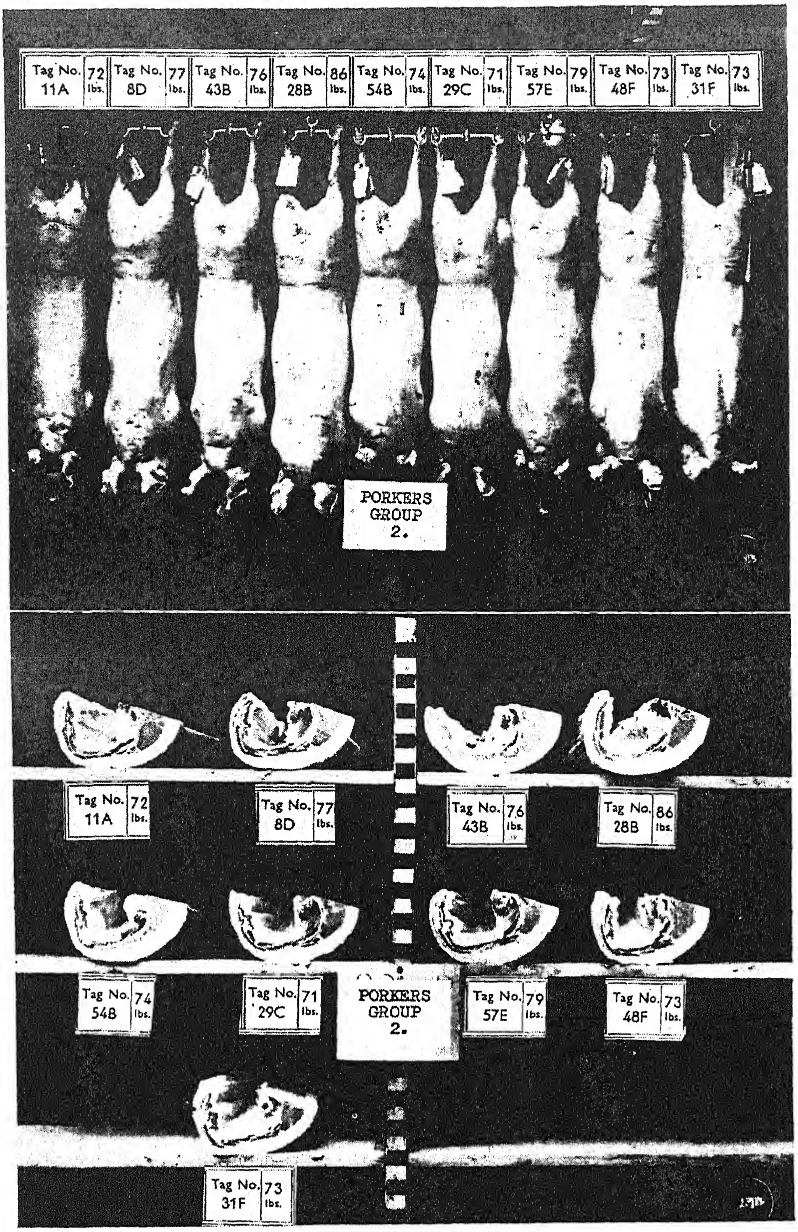

Figure 2.—Group 2 Porkers.

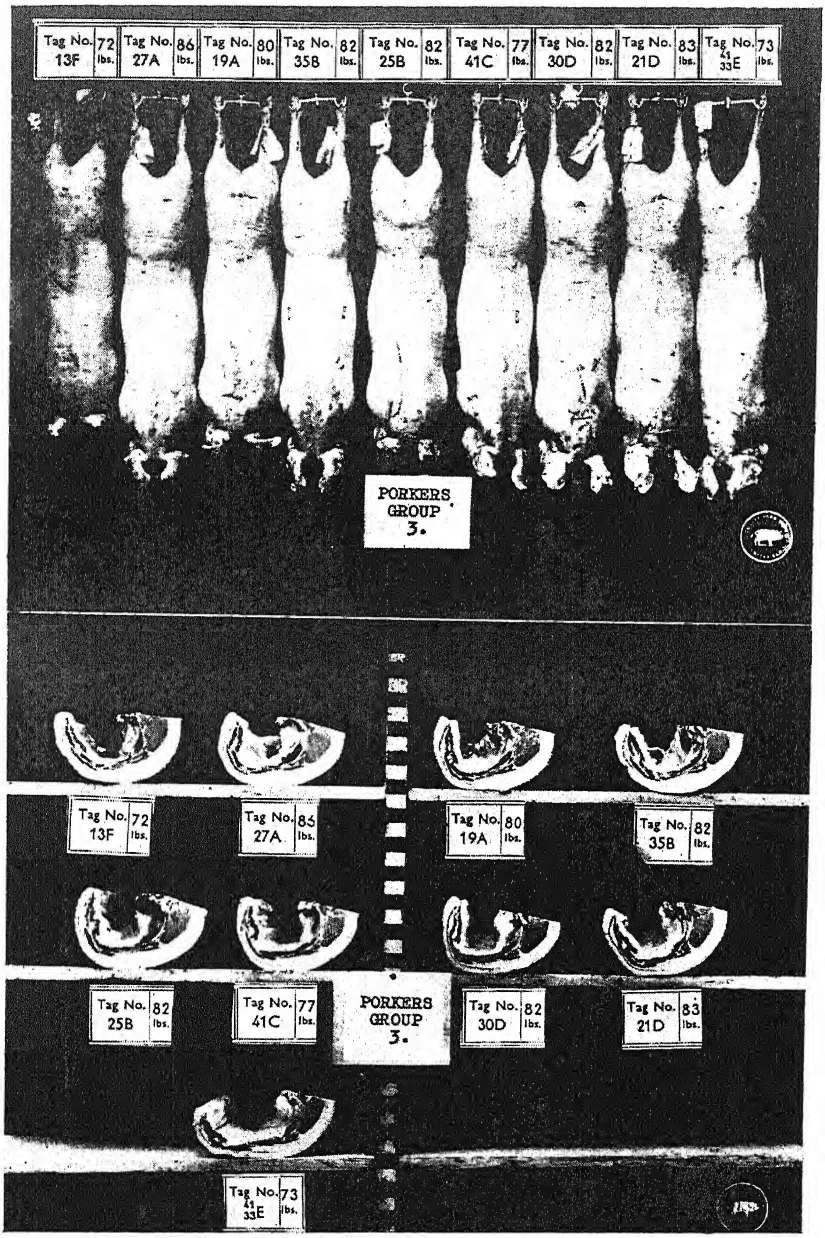

Figure 3.—Group 3 Porkers. Note the scratches on some of the carcases.

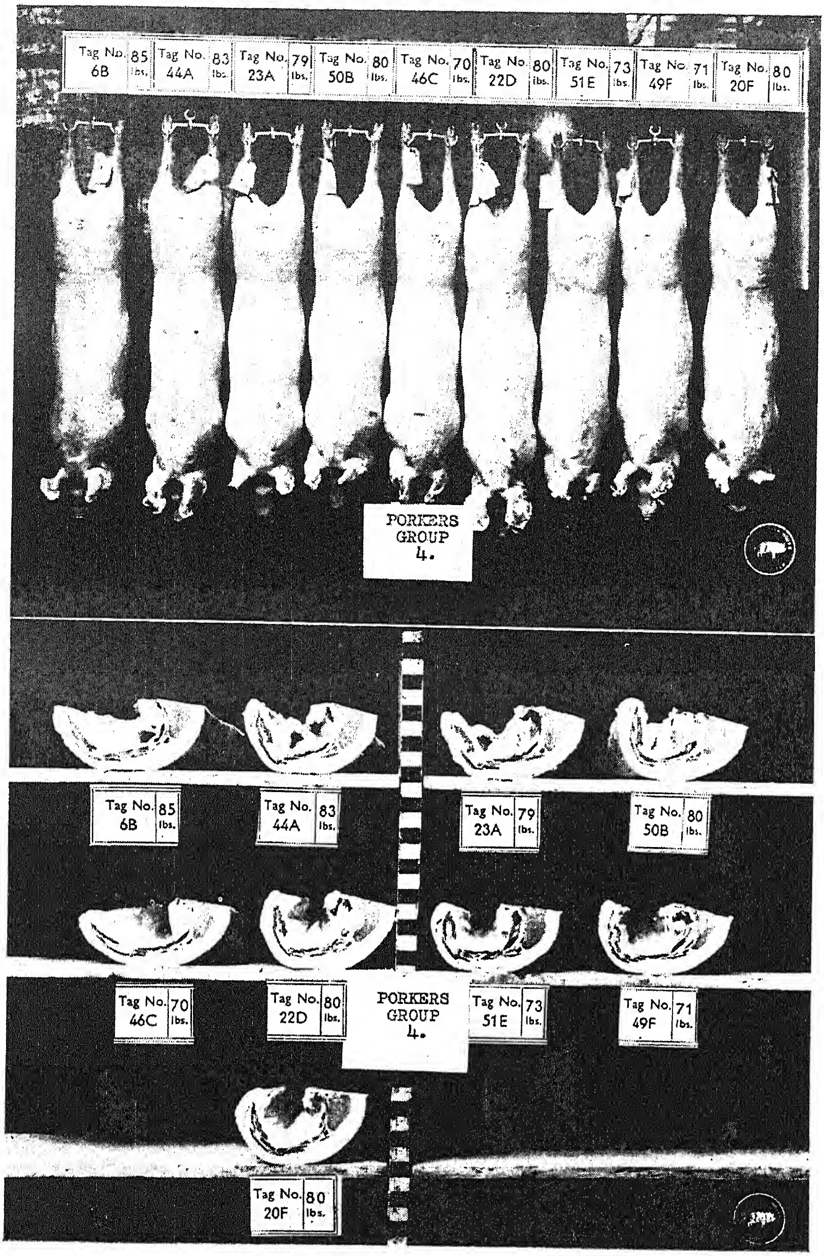

Figure 4.—Group 4 Porkers.

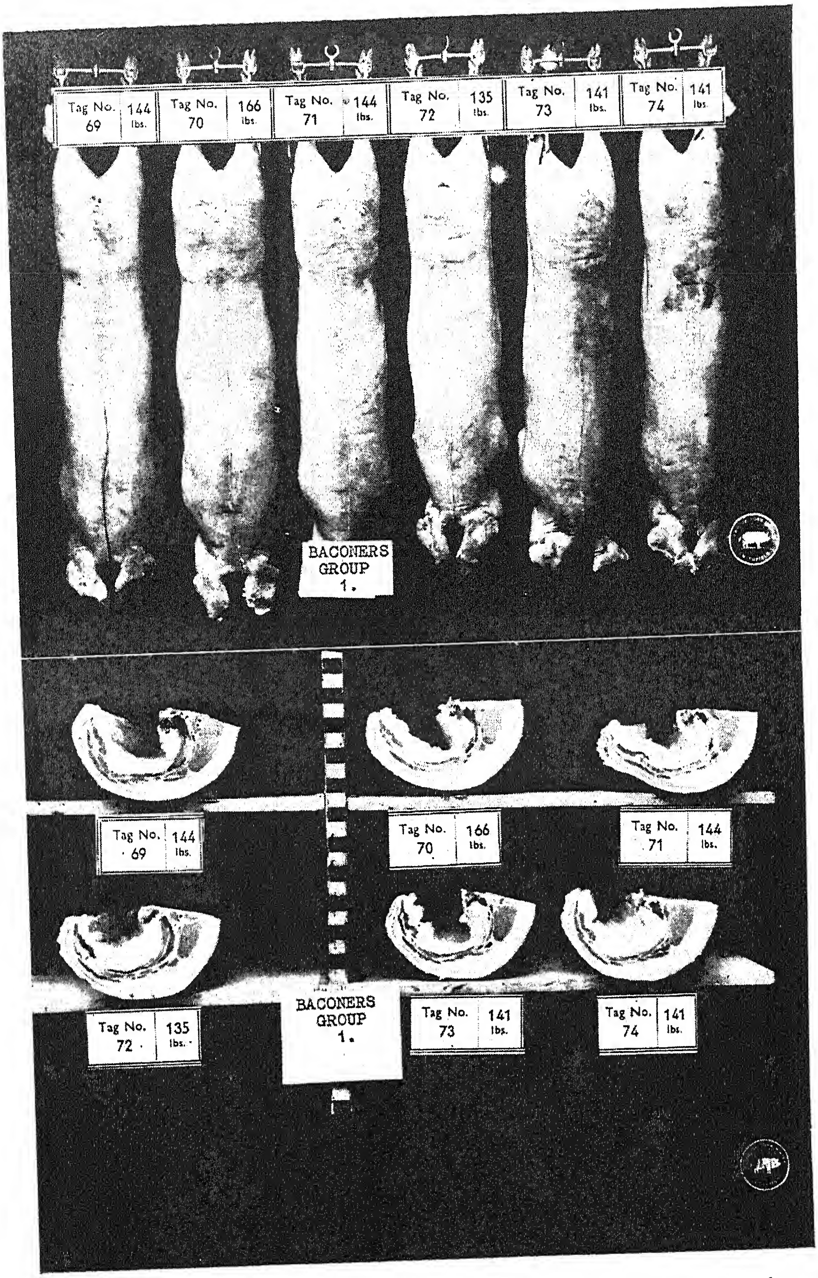

Figure 5.—Group 1 Baconers. Note good length but rather poor hams and deficient lean meat.

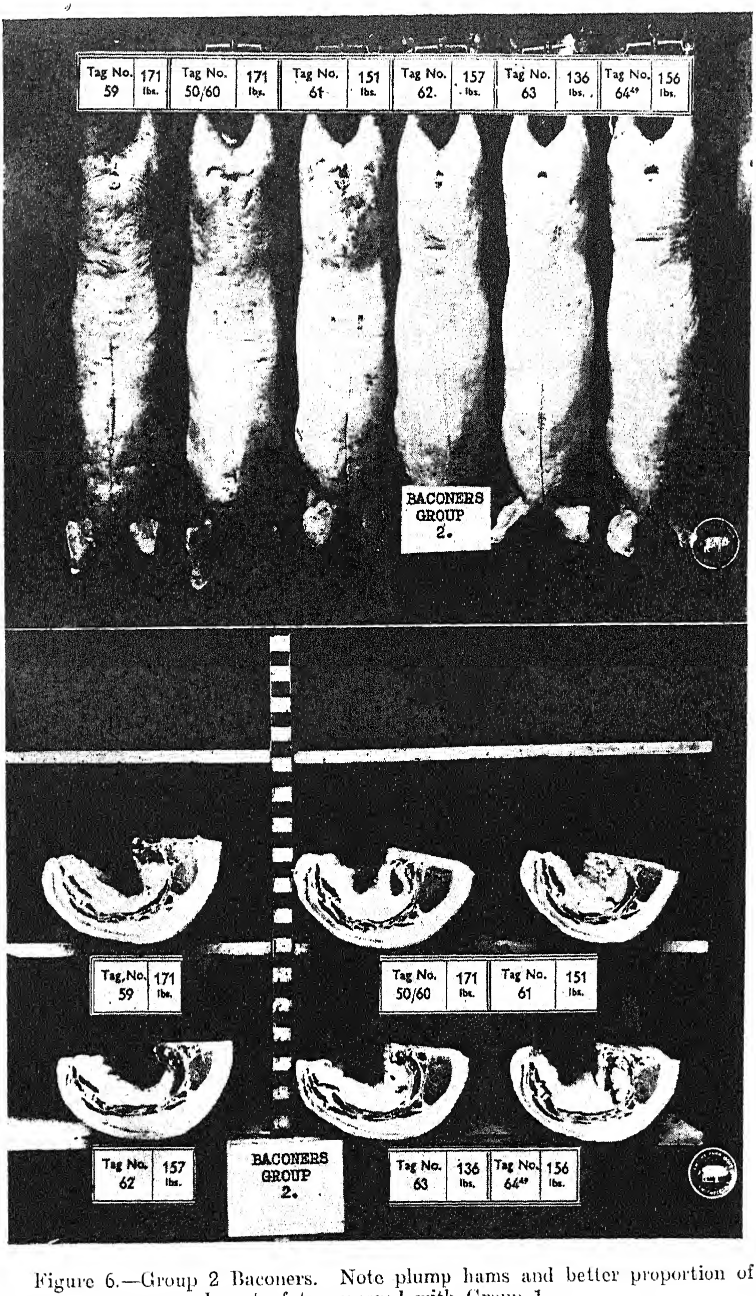

Figure 6.—Group 2 Baconers. Note plump hams and better proportion of lean to fat compared with Group 1.

Standard for award of Marks. Shoulders and Hams.

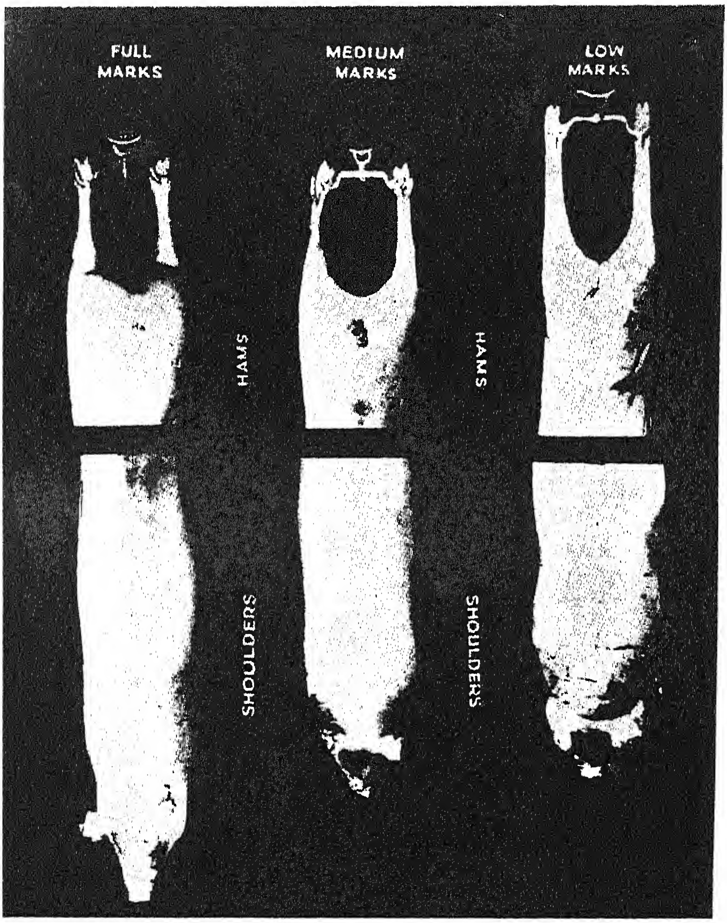

Figure 7.—Photographic scale of shoulders and hams which shows the shape for maximum, minimum and intermediate marks.

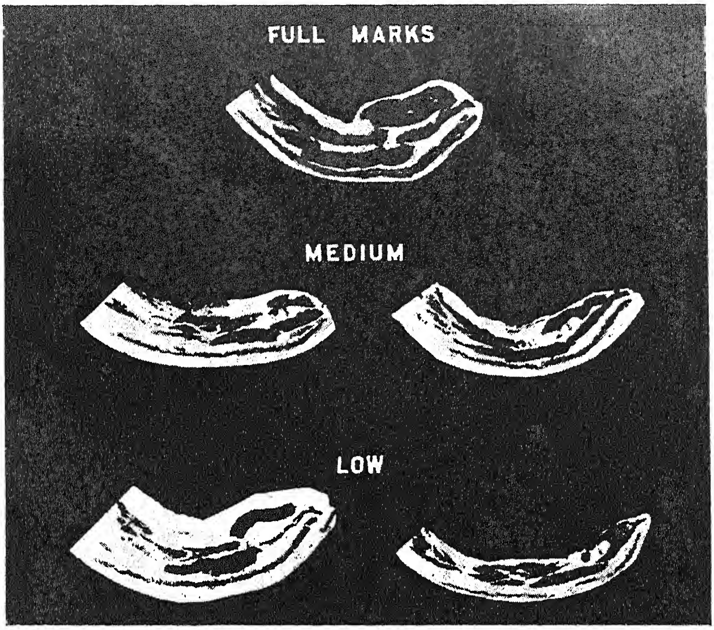

Figure 8.—Photographic scale for Streak (Porker) showing the thickness of streak and amount and proportion of lean to fat required for maximum, minimum and intermediate marks.

Standard for award of marks. Streak (Baconer).

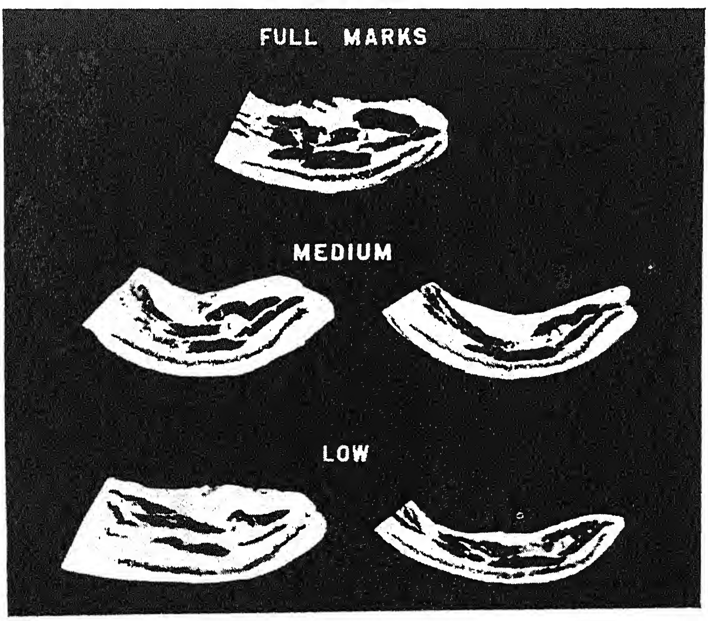

Figure 9.—Photographic scale for Streak (Baconer) showing the thickness of ... and proportion of lean to fat required for maximum,

TABLE II.

	Group.		1		2		3		4	
	Ration and Plane of Intake.		High Protein forced feeding.		High Protein limited feeding.		Normal Protein forced feeding.		Normal Protein limited feeding.	
		Max. Points.	Average.	Average as % of max. points.	Average.	Average as % of max. points.	Average.	Average as % of max. points.	Average.	Average as % of max. points.
Marketing Points.	Colour...	5	5.0	100%	4.9	98%	4.6	92%	4.1	82%
	Skin...	5	4.6	92%	5.0	100%	5.0	100%	4.8	96%
	Dressing...	5	1.8	36%	3.1	62%	3.0	60%	3.7	74%
	Total Marks	15	11.5	77%	13.0	87%	12.8	85%	12.6	84%
Breeders' Points.	*By Inspection*—									
	Hams	8	4.7	59%	4.7	59%	4.7	59%	5.0	63%
	Shoulders	7	4.8	69%	4.5	64%	4.6	66%	4.5	64%
	Streak	12	5.5	46%	5.1	43%	6.3	53%	4.3	36%
	By Measurement.									
	Eye of loin	28	14.7	53%	14.2	51%	17.5	63%	17.1	61%
	Fat over eye	20	0.8	4%	1.1	6%	0.8	4%	0.9	5%
	Length of body	20	4.1	21%	5.4	27%	5.4	27%	5.2	26%
	Length of leg...	5	1.9	38%	1.2	24%	2.9	58%	2.4	48%
	Total Marks...	100	36.7	36.7%	36.2	36.2%	42.2	42.2%	38.4	38.4%

Before discussing the table some explanation is necessary. It will be noticed that the carcases were judged for "Marketing Points" and "Breeders Points." Messrs. Davidson & Swain explain that "*Marketing Points*" for the most part consist of defects which may occur in the industrialisation, dressing or transport of the carcase and which affect the price realised by affecting its appearance when exposed for sale. "*Breeders Points*" consist of defects caused by the breeding or methods of feeding and management adopted on the farm. The Breeders Points are again subdivided into (*a*) those which are based on visual judgment—Inspection Points—and (*b*) those which are based on measurement—Measurement Points. It is of interest to note that "Inspection Points" are obtained by the use of photographic scales and and comparing either the hams, shoulder or streak with these. See figs. 7 and 8.

The standard set was a high one and any carcase which obtained over half the marks on any point is a good one in that respect.

Marketing Points.—*Colour and Skin.*—Both these were considered very satisfactory.

Dressing.—In this respect the carcases showed a large number of scratches (due to fighting on the train), bruises and weals (see figs. 1 and 3) and were, therefore, especially in Group 1, rather heavily penalised.

These are fortunately points which could be easily rectified in future consignments. *It is important for all concerned to remember that pigs bruise and scratch very easily —very much more so than cattle—and particular care should, therefore, be taken not only on the farm, but also in transit and at the export works, to prevent it.*

On the whole the "Marketing Points" were considered satisfactory and varied from 77% to 87%.

Breeders Points.—Messrs. Davidson & Swain reported in great detail on these points and extracts from their report are given in parenthesis.

"Our information is that the experiment involving these four groups was set out to determine whether the proportion of lean to fat in the carcase is influenced by :—

1. A high level of protein intake.
2. Reducing the feed intake during the fattening period.

In this experiment the results indicate that the proportion of lean to fat has not been significantly influenced by reducing the feed intake during the fattening period."

Neither has it been effected by increasing the protein intake.

"In view of the suggestions in the previous report this will probably be an unexpected result. In this experiment the young pigs appeared not to have been grown quickly in early life as shown by the very low average weight of 23 lbs. at weaning. Even without creep feeding, weights of from 25 to 30 lbs. should be reached without difficulty, and it is significant that in New Zealand, where many of the leanest small pork carcases are produced for export, the standard 8 weeks weaning weight aimed at is 40 lbs. It is doubtful if good pork carcases can be made from pigs averaging less than 30 lbs. at 8 weeks old."

"A second complication is that it is, of course, difficult to obtain significant results with small numbers of animals and an experiment of this nature would have to be repeated several times to obtain reliable results."

"The fat general condition of the pigs appears, therefore, to be due to the low weaning weight which interferes with the quick growth required in the early stages of pork production. If the experiment is repeated it is recommended that the preliminary conditions should be that the young pigs are grown quickly in early life."

It was also noted from the detailed data that certain litters gave better results than others. Experienced and observant pig producers will have noticed that not only do the progeny of sows often vary very considerably but also that some sows produce a much more desirable type of pig than others.

In the report on the previous consignment it was stated "The breeding sows should be selected on their performance and, as far as possible, only those kept which produce the type of porker required."

"The low average marks earned by all groups, namely, 38.4% of the total possible, could easily give some discouragement if the marks are not examined closely."

It was pointed out previously that "the standard set is a high one and any carcase which obtains over half marks on any point is a good one in that respect."

"It will be seen that with minor exceptions the points are good with the exception of the fat, and, to a lesser extent, the length. If the fat measurements had been one-third less than they are, not only would the marks have been very considerably higher, but the proportion of fat in the streak would have been about 15% less. If the marks had been awarded on these assumptions the average of all groups would have risen from 38.4% to 56.5%."

"As the eye of the loin gained, on the average of all four groups, 56.7% of marks, which is very good, the only points requiring serious attention are the body length, which average 25.1% of possible marks and the fat. Of these two the fat is by far the more important, and for two reasons. In the first place it is an objection from the market point of view. In the second place while it greatly reduces the total marks awarded to the carcases it is a point which can largely be improved by attention to feeding and indicates that the type of pig is, on the whole, reasonably well suited to the trade. Incidentally it might be pointed out that if one-third of the weight of fat had been deducted from the total weights of the carcases the proportion of marks would have been still higher, as the carcases would have come into lower weight groups for marking."

Firmness of Fat.—A further point on which information was desired was whether the pigs were of a satisfactory firmness for the trade. Samples of fat were taken for analysis by Dr. Callow, of the Low Temperature Research Station at Cambridge, who reports that the iodine numbers were 65.0, 65.5, 65.3 and 65.2 for Groups 1, 2, 3 and 4 respectively.

He states "these figures are definitely on the high side and denote a rather soft, oily fat. The fat from some New

Zealand frozen pork carcases which we have recently examined had an iodine number of about 57 and was a much harder fat."

SUMMARY.

From the detailed report submitted it appears that the type of porker, which can be easily produced in the Colony, was satisfactory except that they were considered a bit deficient in length and too fat. The fat was also soft.

The different factors affecting these were discussed in detail and the following recommendations are made with a view to correcting these defects:—

1. (*a*) Breeding stock with good length should be selected. This will ensure that the progeny will not be deficient in this respect.

(*b*) Sows producing poor type progeny, small litters, unthrifty pigs, etc., should be culled. This can only be done if records of performance are kept. Information on the most suitable type of record to be kept can be obtained from this Department.

2. Young pigs should be forced from after birth by (*a*) not allowing the sows to rear too many piglets. An average of eight for mature sows is ample.

(*b*) Feeding balanced rations high in protein.

(*b*) Creep feeding the young from the third week on.

(*d*) Taking particular care that the piglets do not get a setback at weaning.

3. After weaning the piglets should be forced on a high protein ration until they reach about 60 lbs. live weight when, depending on their condition and rate of growth, their ration should be reduced by about one-third or more, so as to prevent the formation of too much fat.

4. Feeds such as ground nuts, ground nut cake, sunflower seed, etc., should not be fed. These cause soft fat.

BACONERS.

To obtain information on the suitability of the average run of baconers produced in the Colony for export to the United Kingdom and manufacture into prime lean bacon it was rather hurriedly decided to send twelve frozen baconers with the porkers for general and detailed report. Six pigs were obtained from each of two farmers and were kept separate as Groups 1 and 2. Group 1 consisted of Large White x Large Black crossbreds and varied in age from 6 to 7 months at the time of slaughter. Throughout these pigs were fed a balanced ration of maize meal, wheat screenings, meat meal, bone meal and salt, and judging by the age at which they were ready for marketing made fairly rapid growth.

Of the Group 2 pigs detailed particulars were not available. They appeared to have been by a Large White boar out of Middle White x Large Black crossbred sows.

The ration fed to them was a poorly balanced one and at marketing they were approximately 9 months old.

The two groups of baconers were examined before and after slaughter at Bulawayo. Group 1 was definitely the leaner group, as can be seen from figs. 5 and 6, and had fairly good length but was rather weak over the loins and light in the hams. They, however, showed quality. Group 2, on the other hand, appeared much fatter and shorter than Group 1 and better in the ham, but rather lacked quality.

Before the carcases were cut up Group 1 was considered superior to the Group 2 for bacon production by Messrs. Geo. Kean & Co., Ltd., Smithfield, and other competent judges. On the whole, however, the "trade" considered the carcases as of a fairly suitable type and quality which would find a ready market in the United Kingdom.

Prices Realised.—The carcases sold at an average price of 5.75d. per lb. dead weight. Taking slaughtering, freezing and export charges at 2d. per lb. this returned 3.75d. per lb. dead weight or 3d. per lb. liveweight at Bulawayo.

Messrs. Davidson & Swain also reported in detail on these carcases as follows:—

"The scale on which baconers are judged under the present method represents what is known as Class 1 Wiltshire pig under the British Bacon Scheme. Judged on this standard the present consignment is rather too fat, but the carcases are nevertheless a level lot which would find a good outlet in the market. On external examination Group 2 appeared to be too thick and fat, but internal inspection showed them to be the superior group. (See figs. 5 and 6.) This is in virtue of the higher proportion of lean to fat in the carcases as seen, notably in the 'eye' of lean and in the streak. Group 1 were larger for their weight, but the leaner external appearance was due largely to lack of lean meat rather than absence of fat, which was actually greater than in the case of the older group. It would seem likely that these two groups represent different breed types."

SUMMARY.

The baconers were considered to be both too fat and deficient in lean in the one case and deficient in lean in the other. The causes of these defects are exactly the same as was described in detail for porkers and can be remedied by following improved methods of breeding, feeding and management.

The Division of Animal Husbandry wishes to express its appreciation and thanks to all who assisted in making this experiment a success.

Witchweed and the Labour Shortage.

By S. D. Timson, M.C., Assistant Agriculturist.

Farmers in most parts of the maize belt report an increasingly serious shortage of labour, which will naturally react adversely on the campaign against witchweed, since hand cultivation is still the most widely used weapon against this parasite. It is thought that in some cases where the shortage of labour is at its worst that the method of destruction of witchweed by spraying with a dilute solution of sodium chlorate may come into its own in these special circumstances and relieve the labour shortage.

In an article published in the January, 1933, issue of this journal the writer gave the results of and conclusions drawn from a large-scale trial of this method of control carried out in co-operation with Mr. A. G. McCall on his farm at Glendale, and the reader is referred to this for details of the practice. Briefly, the results of this and other trials were as follows:—

(1) A $1\frac{1}{2}$ per cent. ($1\frac{1}{2}$ lbs. in 10 gallons of water) solution of sodium chlorate when properly applied in the form of a fine spray gave 100 per cent. kill, and none of the parasites killed grew up again from the same "roots" or stems.

(2) Spraying by the simple system outlined was more than twice as rapid as light surface hoeing. By the former method the rate of work was 1.08 boy-days per acre, and by the latter method 2.36 boy-days per acre.

(3) Spraying was found to be cheaper than hand cultivation.

(4) Spraying with sodium chlorate when the infestation is severe would cause an undetermined loss in the yield of maize owing to the poisoning of the maize plant by contact

of the spray blown on to the leaves, and by the passing of the poison through the junctions between parasites and maize plants into the latter.

(5) It was found that three boys working one pneumatic pump were able to spray a light general infestation at the rate $7\frac{1}{3}$ acres per 10 hours working day.

Owing to the capital cost of the spraying apparatus the writer has not advised the use of this method in the past, except in exceptional circumstances, but if a farmer finds himself faced with such a shortage of labour that he cannot control the parasite by hand cultivation he is strongly advised to give spraying a trial, and face the considerable capital cost of the necessary outfit rather than allow the parasites to seed down and destroys years of work. The only type of apparatus recommended is the pneumatic type knapsack sprayer (of at least 3 gallons capacity) with a hand-trigger control. The trigger control is considered essential in order to avoid wastage of the sodium chlorate.

Farmers are advised to review their labour position carefully, and if they decide that there is likely to be a shortage, they should place their orders for the spraying outfits at once, since it will probably be found necessary to obtain them from outside the Colony.

Supplies of sodium chlorate should also be ordered at once, and the amount of the latter required per acre of a fairly severe general infestation would be between three to 6 lbs. per acre.

A pneumatic type of sprayer has been specified above as necessary, but if the ordinary knapsack sprayer can be obtained with a trigger control instead of a turn tap, or if it can be fitted with trigger control, it would be quite satisfactory.

Fire Hazard.—It is desirable once again to warn those using sodium chlorate as a spray that articles of clothing, including boots and shoes, sacking and similar organic materials, which become soaked in the solution, on drying out are very inflammable, and should be thoroughly washed after use to avoid the danger of fire.

Another method of economising hand labour has been repeatedly advised by this Department in the past, but never, as far as the writer is aware, adopted in this Colony, and that is the use of single draught animals (oxen, donkeys or mules) for pulling a light cultivator with cutting points (such as the horizontal duck-foot type), for continuing with the cultivation of witchweed between the rows, after the maize is too high for other types of cultivator.

Nearly every farmer has a few quiet old oxen suitable for this work and can make single-ox yokes from farm materials as first described in the March, 1930, issue of this journal. The purchase of a few donkeys will be vastly cheaper than the results of leaving witchweed to seed down in the land.

The following is the description of the single-ox yoke taken from the note mentioned above written by C. A. Kelsey Harvey, and the accompanying illustrations make the matter clear.

"There are reproduced herewith three photographs of a single ox yoke made from native timber which has been doing effective work on the Tobacco Experiment Station this season. This yoke was devised principally to cultivate closely spaced crops such as beans, ground nuts and sunnhemp grown for seed. The ordinary type of double cultivator yoke is generally too cumbersome when crops are spaced less than 3 feet apart. It was also found useful for cultivating up and down the lines of tree plantations on the station, and should be valuable for the late cultivation of 'witchweed' infested maize crops.

"The yoke is cut from a forked branch of M'sasa or M'hasha wood and shaped with an adze to fit the animal's neck. Two ring bolts are inserted 8 inches to 10 inches from the top of the yoke, to which are attached the traces made of ordinary reims. The two ends of the fork are shaped like skeys and are notched to take the strop. The yoke when completed is 2 feet 6 inches in length, and weighs 12 lbs. when the wood has dried out."

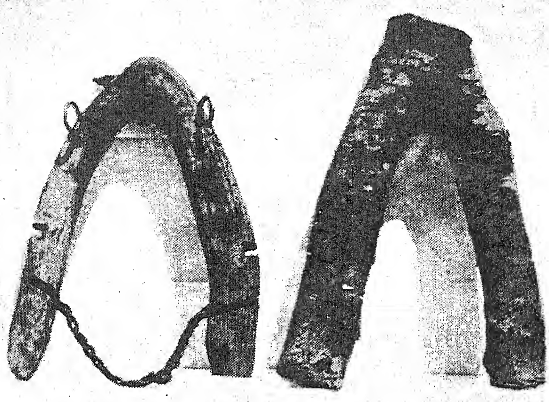

FIG. 1.

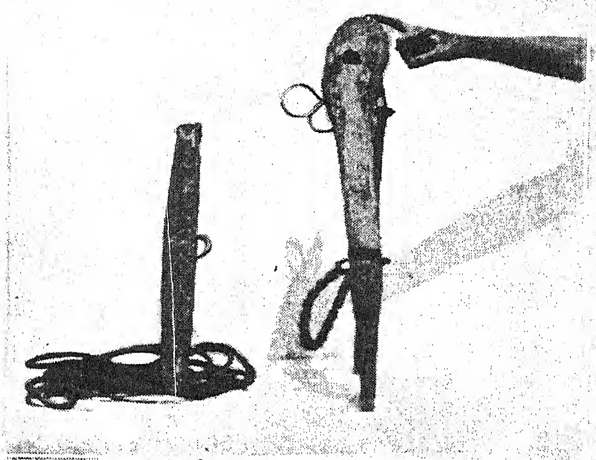

FIG. 2.

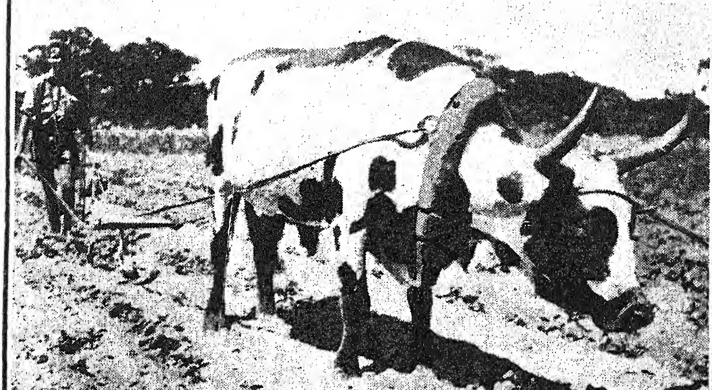

FIG. 3

Ticks Infesting Domestic Animals in Southern Rhodesia.

By Rupert W. Jack, Chief Entomologist.

Revised. November, 1936.

METHODS EMPLOYED IN CONTROLLING TICKS.

Cattle Ticks (*Ixodidæ*).—A number of methods have been recommended from time to time in respect to the destruction of the common cattle ticks (family *Ixodidæ*), and probably several of these are still employed in other countries, but as far as South Africa is concerned, dipping in an arsenical solution is almost universally adopted when any considerable number of cattle have to be treated. Spraying is sometimes resorted to in the case of small herds. Before dealing with the subject of dipping, it may be as well, however, to touch briefly on one or two other methods.

(1) *Spraying with Paraffin and Water.*—Paraffin is one of the most potent insecticides known and kills ticks very rapidly by contact. It does not do a great deal of harm to animals even if sprayed in the pure state on to their hides, but is, of course, very expensive. It has the disadvantage of not mixing readily with water, and so can only be diluted in a specially constructed pump which mixes the paraffin and water mechanically in the delivery hose pipe. Experiments have shown that the minimum effective strength against ticks is 15 per cent. paraffin in water, and for reliable effect the pump is usually adjusted to 25 per cent., as even the best pumps of this design are uncertain in their delivery. This form of spraying is effective, but troublesome, laborious and very expensive compared with the use of arsenical dips.

(2) *Hand Dressing.*—Smearing the udders of cows and the inside of ears of stock with greasy preparations to destroy ticks which attack these parts and are not readly killed by dipping is of considerable value. Tick greases of this nature are on the market. Crude petroleum is stated to be of value in this connection, as also is a mixture of paraffin oil and paraffin wax, according to a formula designed by Lieut.-Col. Watkins-Pitchford in Natal, *viz.*, paraffin oil, one quart; paraffin wax candles, No. 6, 6 to 8. One quart of paraffin should be *cautiously* warmed in an open vessel and the candles broken in small pieces, dropped into the oil, when they will rapidly dissolve. In hot weather it will be found that eight candles to the quart are necessary to produce a mixture of the required consistency, while during cold weather five or six candles will be found sufficient.

(3) *Burning the Grass.*—This operation is of some value in reducing the number of ticks where it can be carried out and if it be done intelligently. Ordinary winter burning effects little, as the ticks are more or less dormant during the cold weather. For the purposes of tick destruction it should be carried out after tick life has revived, that is *as late in the season as possible.* October, or even November, if the weather permits, are probably the best months from the tick killing point of view.

(4) *Starvation.*—Ticks will live for a number of months without feeding, but they are not immortal, and if all animals can be kept away from pastures for a sufficient length of time the ticks present must die out. Conditions in Southern Rhodesia are, however, probably less favourable to the adoption of starvation measures than those in any other parts of the world owing to the abundance of animal life, such as small buck, hares and jackals, ground vermin, etc., that occur on most farms and cannot be kept out of an ordinary fenced paddock. Elaborate methods based on the life history and known duration of the different feeding stages of ticks have been

evolved and applied in the United States of America, but, although the writer has details of these methods before him, it appears unnecessary to deal with them in the present article, as they are quite unlikely to be adopted in this Colony. As a general statement, it has been affirmed that if a piece of land can be kept absolutely free from tick hosts for a period of fifteen months the ticks must be eradicated (Theiler). Ticks will, howeved, live longer than this in confinement, as the writer clearly recalls a fëw Brown Tick nymphs surviving for eighteen months in a glass bottle at Cape Town during the time he was assisting Mr. C. P. Lounsbury in disease transmission experiments.

(5) *Dipping.*—There is no intention of dealing exhaustively with the subject of dipping in this article, but it is desirable to mention the fundamental principles underlying the practice as at present applied in this Colony.

The active agent of an effective dip against ticks is arsenic in a soluble form. As a matter of fact, arsenite of soda is the chemical almost universally employed in both home-made and proprietary dips. Good results were obtained in the initial experiments in the Cape Colony with a plain solution of this chemical in water, generally employed at that time as a 14-day dip at a strength of 1 lb. of 60 per cent. arsenite to 25—30 gallons of water. There are, however, two alleged drawbacks to the use of the plain solution, namely, that it is slightly inclined to injure the skin of the animal, especially with repeated applications, and that, owing to the high "surface tension" of water, it does not "run" over-well, and is therefore slightly deficient in wetting power. It may sound somewhat curious to state that water is deficient in wetting power, but none the less the addition of certain agents diminishes the surface tension of the liquid and presumably causes it to penetrate more thoroughly to the hide of the dipped animal through the hair. The addition of soap, for instance, has a marked effect in this direction. It is obvious,

therefore, that the addition of substances to the arsenite of soda solution which will check the caustic action on the hides of the animals and cause the liquid to wet the animals more thoroughly is an advantage. There is no great difficulty about this, and most proprietary dips have a special formula of their own. The following formulæ are, however, the ones devised by Watkins-Pitchford in Natal for different intervals between the dips, and are generally referred to as the

LABORATORY DIPS.

	3-day.	7-day.	14-day.
Arsenite of soda 80 per cent.	4 lb.	8 lb.	12 lb.
Soft soap	3 lb.	6 lb.	6 lb.
Paraffin	1 gall.	2 galls.	2 galls.
Water	400 galls.	400 galls.	400 galls.

The soap and arsenite should be dissolved separately in a sufficient quantity of hot water; the soap solution should then be added to the paraffin and beaten up into an emulsion; mix both solutions together and add water to make up 400 gallons, stirring vigorously in the meantime.

Sir Arnold Theiler, in a recent publication,* states that "most farmers now omit the soft soap and paraffin and use a plain aqueous solution of arsenite of soda, adhering to the strength laid down in the Pitchford formula and using 1 lb., 2 lb. or 3 lb. per 100 gallons of water, according to whether three-day, five to seven-day, or fourteen-day dipping is contemplated." It would appear, therefore, that the advantages of the emollients in the dip are not universally considered sufficient to justify the extra expense involved in their use.

In parts of the Colony where the Cattle Cleansing Ordinance is in force seven-day dipping is obligatory. Fourteen-day dipping, although a greater strength of dip is used, is not so effective in eradicating certain ticks as the weaker solution used more frequently. Three-day dipping is employed in dealing with outbreaks of East Coast Fever. In the South African Union, however, seven-day dip strength

*"Diseases, Ticks and their Eradication." Journ. Dept. Agric., S.A. Union II., No. 2.

used at five days' interval is stated by Theiler to be coming into favour in dealing with East Coast Fever outbreaks, three-day dipping having not always proved effective. The dipping is supplemented by hand-dressing of the depths of the ear, the sheath, anus and brush of the tail.

The reason for this increased effectiveness of the shorter interval dipping against certain ticks lies in the length of time occupied by the various stages in feeding. Ticks with a life cycle of the three host type are less easily eradicated by fourteen-day dipping than those which feed only on one host, for the reason that the immature stages may attach, feed up and fall off again between the dips, whereas the Blue Tick, for instance, which passes through all its stages on the one host and occupies some three weeks or more in the process, must undergo immersion at least once, even at the fourteen-day interval, and would frequently undergo two. With ticks feeding on three hosts in the course of their development, of which the Brown Tick may be taken as an example, the larval feeding period is the shortest, then the nymphal, and then the adult. The idea of the three-day dip is to ensure that all the larvæ undergo at least one immersion, and, of course, the nymphs and adults as well. Cattle will not, however, endure too frequent dipping at the greater strengths without injury, and the dip needs to be weakened in proportion as the interval is decreased, and owing to the greater susceptibility of the larval and nymphal stages, they can be destroyed by the weaker dips, although at some sacrifice of killing power as regards the adults. As the infection of East Coast Fever is taken up by the larvæ or nymphs, and is not transmitted through the eggs, it is the two early stages of the tick that it is most important should be quickly destroyed in checking an outbreak. Regular dipping at the seven-day interval will eventually eradicate the Brown Tick, but it would take considerably longer to check an outbreak of the disease than the three-day dip.

Ticks which feed well inside the ears, like the Red Tick larvæ and nymphs (and this species is also an agent in trans-

mitting East Coast Fever), are not effectively killed by dips. The same remark applies to ticks which attach to bare parts of the body, as the Red Tick adults do under the tail, or in the brush of the tail, and these must be treated by hand-dressing in fighting an outbreak.

HOW DO ARSENICAL DIPS KILL TICKS?

Compounds of arsenic, as is well known, are largely used as stomach poisons in insecticidal practice, having been found effective against leaf-eating insects, apple codling, and, in fact, any insects whose feeding habits render it possible to place the arsenic in such a position that it is eaten with the natural food or with some artificial food attractive to the insects concerned. As a contact insecticide arsenic has been found in agricultural and horticultural practice to have little value. Compounds of arsenic used for application to plants are, however, practically insoluble in water, because the soluble compounds are deadly to plant life. Arsenite of soda, which forms the basis of arsenical cattle dips, is completely soluble in water, and it is highly probable that it has considerable action as a contact insecticide, being absorbed by the ticks, at least in certain stages of their development. The writer recalls some experiments carried out in Cape Town under the direction of Mr. C. P. Lounsbury, in which engorged female blue ticks were taken from an unsprayed animal and placed in contact in the dishes, used for rearing ticks at the time, with hair cut from an animal recently sprayed with arsenite of soda solution, the hair being cut after drying. These ticks behaved very much as ticks taken from a sprayed animal, either dying without laying eggs, or, if a few eggs were laid, these usually failed to hatch. A very few larvæ occasionally hatched. In this case it was obvious that the poison was absorbed through the skin of the tick. The reduced effect of arsenical dips on ticks which attach to bare places on the host also indicates that contact with hair coated with arsenic is a factor in bringing about the destruction of these parasites.

It has, however, been shown that regular dipping results in the tissues immediately underlying the skin of animals

becoming stored with arsenic. This is stated to be a condition which is gradually acquired, the system becoming accustomed, with the continuance of dipping, to hold the arsenic without detriment to the animal. The storage of arsenic in these tissues does not go beyond a certain point, and the poison is rapidly eliminated if dipping is discontinued. The arsenic in these tissues is sufficient under conditions of regular and short-interval dipping, as was first shown by Lounsbury at the Cape in 1904, to kill a certain percentage of the ticks, especially larval ticks, which attach, even if they have not been through the dip, and also apparently to prevent some proportion of ticks from attaching at all. It appears, therefore, that arsenical dips act also as a stomach poison on ticks, and that enough may be taken in through the mouth parts from a regularly dipped animal to cause death.

One point which, as far as the writer is aware, has not been fully elucidated is the exact cause of the reduced efficacy of dipping against such ticks as the Bont-leg and the Bont. These ticks possess much longer beaks than the Blue and Brown ticks and their allies, and it may be that these penetrate too far through the skin to take up the arsenic. On the other hand, they have a much tougher skin than the smaller species of ticks, and may on this account absorb less arsenic from the hair. Also, the females, being larger, are less well covered by the hair of the host. Whatever the reason may be, these large ticks, particularly the Bont-leg tick, persist in regularly dipped herds long after the Blue and Brown ticks have been practically eliminated. The fact that the early stages of the Bont-leg are passed on wild, or at any rate undipped hosts, of course gives this tick a great advantage.

CONTROL OF TICKS OF THE FAMILY ARGASIDAE.

Spinose Ear Tick.—This tick, owing to its retreat far inside the ear, does not yield to ordinary arsenical dipping. The ears of the infested animals need to be dressed by hand. There are proprietary dressings for this purpose on the market.

Mr. G. A. H. Bedford, Entomologist, Division of Veterinary Research, South African Union, recommends the following:— "Two parts each Stockholm tar and oil to one part turpentine. Sweet oil was always recommended formerly, but cheaper oils have been found to be equally effective." From a teaspoonful to a tablespoonful should be poured into each ear according to the size of the animal. On badly infested farms it may be necessary to treat animals every two or three weeks, in exceptional cases once a week, otherwise treatment at monthly intervals is sufficient.

Permanent kraals, especially those built of loose stones or bricks, should be avoided. Wire kraals are best, and the position should be shifted as soon as the ticks show a sign of increase. Brushwood packed along the fence will afford shelter to the animals, and should be fired after the wire has been removed. For permanent kraals and cattle sheds good brick work plastered over so as to afford no lurking place for the ticks is desirable.

It need hardly be said that cattle introduced from the South African Union, especially from a known Spinose Ear Tick area, should be hand-dressed carefully to avoid the risk of introducing the tick to Rhodesian farms.

Tampan.—As this tick leads an independent life from first to last, taking only a space of time measured by minutes over its feeding operations, it is not possible to control it by any treatment of its hosts. The seclusion of its diurnal retreats further renders its destruction a very difficult matter indeed. As a human pest in native huts of an ephemeral form of construction the situation is best met by burning the whole structure down and building anew elsewhere. To avoid being bitten by this pest and so running the risk of contracting relapsing fever, any spots regularly frequented by natives should be avoided, particularly native huts and sandy spots where travelling natives regularly camp. The instance of the infested pig-sties already mentioned constituted a practically hopeless case. The tick can, of course, be destroyed

by heat, but large numbers invariably escape the most thorough firing if the stone or brick walls afford sufficiently deep hiding places, as such walls almost invariably do. Plastering or tarring over the surfaces of the walls and so imprisoning the ticks is practicable in certain cases. In building permanent pig-sties the walls should certainly be constructed so as to afford as little shelter for the ticks as possible. Brick walls covered with cement and cement floors are almost ideal as far as cleanliness and parasite control are concerned. These ticks are probably largely spread in the bedding and clothing of natives, and a single fed female, dropped in favourable surroundings, may be the means of gradually infesting an extensive building in a gross degree.

The Fowl Tick.—Consistent care when introducing new birds to one's houses or runs, provided there are no very close neighbours, should keep away infestation with this tick indefinitely. The pest is, however, extremely prevalent in the Colony, and, as is constantly emphasised by the Poultry Officer of the Department of Agriculture, its presence is not only an adverse factor in regard to the yield of eggs, but is the cause of death of a large number of birds. Fowls certainly become more or less immune to the disease conveyed by the ticks, and chickens reared on the premises may not show a high mortality. New birds from uninfested premises, however, commonly succumb very quickly when exposed to infection, and this is particularly disappointing if a high price has been paid for them. When commencing poultry keeping on clean premises, therefore, no birds should be introduced without the most careful precautions. As already stated, the larval stage of this tick remains attached to its host for an average of about five days, and it is in this stage that the tick is frequently introduced. Birds from elsewhere are, therefore, best kept in separate crates for ten days or more to allow of any larvæ dropping off, and then the crates should be burnt. Needless to say, these crates, with the contained birds, should be kept away from the fowl runs, and

precaution should be taken against the escape of any ticks which may drop off. This is the most difficult point. Probably the easiest method is to place the crates in the middle of a quantity of dry grass, into which the engorged larval ticks, after leaving the birds, will penetrate. This grass should be in such a position that it can be burnt without moving it. Coops, crates and other poultry accessories may, of course, harbour the ticks in any stage, and, if too valuable to be destroyed, can be soaked with paraffin. It is best to take them to pieces for a thorough cleaning, over a sheet of iron, or something similar, to prevent any ticks being dropped about where they cannot be seen, and to reconstruct them again. As an alternative they can be soaked for several days in a solution that will kill the ticks.

The most comprehensive report of tests of substances against the Fowl Tick in the writer's hands is contained in a bulletin published by Mr. D. F. Laurie, Poultry Expert of the Department of Agriculture in South Australia, in 1912, under the title of "The Poultry Tick." From these tests the fact emerges, as emphasised by the author, that paraffin emulsion "stands out as the most effective and cheapest in use." Other substances which killed the ticks, but only at strengths that rendered their use either expensive or quite impracticable, included:—Carbolic acid, 5 per cent.; phenytas, 5 per cent.; Jeyes' fluid, 10 per cent.; lysol, 10 per cent.; Cyllin, 5 per cent.; cresol soap, 5 per cent.; formalin, 2½ per cent.; caustic soda and caustic potash, 10 per cent. Paraffin emulsion has long been recommended as a means of destroying these ticks, but the formula given by Mr. Laurie (*i.e.*, paraffin, one part; boiling soap suds, nine parts) differs somewhat from the emulsion as usually prepared in this Colony and appears to provide for a very variable quantity of soap. The following is a more exact formula:—

Soap	1 lb.
Paraffin oil	4 gallons.

Cut up soap and boil until dissolved in 2 gallons of water. Remove from fire and immediately add to the oil. Churn up violently for fully five minutes by pumping through spray-pump, or fully ten minutes with a paddle, until a creamy uniform liquid is formed. This constitutes the stock solution, which will keep indefinitely. To make a solution containing 10 per cent. of paraffin add $5\frac{2}{3}$ gallons of water to each gallon of the stock solution.

The treatment of infested premises calls for great thoroughness. Houses constructed entirely of iron, as many fowl houses are, can be roasted by burning a quantity of dry grass within and the ticks exterminated in this way. The writer has used a plumber's blow-lamp with good effect in brick buildings, but even so it is remarkable how the heat fails to penetrate deep cracks between the bricks, and many ticks escape a piecemeal treatment of this nature. Spraying the houses once a fortnight with a 10 per cent. solution of paraffin emulsion, applied as hot as possible, is a good measure to keep down the pests. Pure paraffin is a good destroying agent to run into any cracks known to harbour the ticks. Brick walls should, if possible, be given a cement coating to do away with the natural hiding places of the ticks and imprison such as may be present. Wood work can be covered with hot coal tar to seal up the crevices. The smooth walls of *pisé* work afford practically no foot-hold for the ticks, provided they are free from cracks; in fact, the golden motto is to avoid cracks in the walls of the houses as much as possible. The perches should be removable, and be taken down regularly for cleansing purposes. Infested houses of rough wood and grass, which can easily be replaced, are best destroyed by fire. Wood and iron buildings can be taken down, thoroughly cleansed and re-erected, preferably on a new site. The ground where the old house stood can be saturated with paraffin or heavily fired by burning grass and brushwood on the surface.

TABLE OF DISEASES KNOWN TO BE TRANSMITTED BY SOUTH AFRICAN TICKS.

Disease.	Host.	Ticks conveying
East Coast Fever	Cattle	Brown Tick Red-legged Tick Black-pitted Tick Cape Brown Tick Probably others or same genus (*Rhipicephalus*)
Redwater	Cattle	Blue Tick Brown Tick Red-legged Tick
Gallsickness ... ... (*Anaplasmosis*)	Cattle	Blue Tick Black-pitted Tick
Gallsickness ... ... (*Gonderia mutans*)	Cattle	Brown Tick Red-legged Tick
Biliary Fever of the Horse...	Horse Mule Donkey	Red-legged Tick
Biliary Fever or Malignant Jaundice	Dog	Dog Tick European Brown Tick
Heartwater	Cattle Sheep Goats	Bont Tick Variegated Bont Tick
Spirillosis	Horse Cattle Sheep	Blue Tick Red-legged Tick
African Relapsing Fever... ...	Man	Tampan (*Ornithodoros moubata*)
Spirochaetosis	Fowls	Fowl Tick Tampan

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The illustrations in the Plates are original with the exception of figs. 15 and 16 on Plate I., which were roughly copied at a reduced size from Messrs. Wm. Cooper & Nephews' pamphlet "Ticks in relation to Diseases of Stock," and the figures of the Spinose Ear Tick on Plate II. The latter were copied or compiled from figures appearing in Messrs. Nuttall & Warburton's "Ticks: A Monograph of the Ixodoidea."

FRUIT SWEETS.

By Miss T. Hoek, Union of S.A. Department of Agriculture and Forestry.

Fruit sweets are always acceptable, and now that the fruit season has arrived and a lot of fruit is sometimes wasted on the farm, provision should be made for the leaner times.

Sweets, in most cases, are a daily demand with children, and an excellent habit to teach the child is to make him expect his sweet regularly after every midday meal, and naturally a fruit sweet is more advantageous to him than one consisting principally of sugar.

Fruit sweets may be boiled or unboiled. The boiled type may be made of fresh or dried fruit, while the unboiled sweet is usually made only of dried fruit. Both kinds are rich in vitamins and mineral salts, but the unboiled sweet usually is richer in these constituents than the boiled one.

Boiled Sweets.—In this case one kind of fruit may be used, although a good combination may be obtained by boiling two or more kinds of fruit together (especially if an insipid fruit is combined with a strong-flavoured one).

Method.—Clean the fruit by washing, rub off the hairs and cut up the fruit, and then boil until soft and pulpy. When hard fruit, which is not too juicy, is boiled, a small quantity of water should be added. Ripe apricots, free-stone peaches, grapes, figs and mulberries usually contain sufficient water. The fruit should be stirred occasionally to prevent burning. When boiled to a pulpy consistency, the fruit is rubbed through a sieve and measured, $\frac{1}{4}$ to $\frac{1}{3}$ cup of sugar being added for every cup of fruit pulp. The mixture of fruit pulp and sugar should now be boiled quickly until sufficiently thick to remain clear of the sides of the pot when stirred. It is desirable to stir the mixture to prevent burning.

When using dried fruit it should be soaked overnight before being boiled. Dried fruit and fresh fruit may also be combined.

Spices and lemon juice may be added to most fruit sweets, according to taste. The spices should first be bruised, then tied in a piece of cheese-cloth and boiled in the fruit pulp for a while. Ground spices usually impart a dark colour to the pulp. Naturally, the essences of the various spices are preferred (*e.g.*, clove oil) in view of their being available in clear liquid form. Care should be taken to avoid an excessive use of spices. Lemon juice is usually added at the end of the boiling process.

As soon as the mixture stops clinging to the sides of the pot it is poured on to buttered boards and spread in a layer about $\frac{1}{2}$ to $\frac{3}{4}$ inch thick. It should then be left for a few days, when moulds are used to press out the sweets. Roll the sweets in sugar, allow to dry and then pack away in bottles or in layers between waxed paper in boxes. Instead of using the fresh or dried fruit whole, the fruit pulp remaining after the juice has been strained may be used for fruit jelly or fruit drinks. In this case especially lemon juice and/ or spices are added with excellent results.

Unboiled Fruit Sweets.—In this case the dried fruit is ground. If the fruit is soft, as for instance, raisins, prunes, figs, dates, etc., only the stones are removed before the fruit is ground. If the dried fruit is hard and slightly dry, it is placed in cheese-cloth and dipped in boiling water for a few minutes; it is then removed and allowed to drain in the cloth for a few more minutes. The fruit should then be ground.

Various kinds of dried fruit may also be combined, while nuts may also be added.

Sugar, or preferably honey, is then added to the ground fruit, according to taste. Honey not only has the desired sweetening effect, but also gives the sweet an agreeable flavour, keeps it in a moist state for a long time, and assists in increasing the mineral salts in the sweet.

The sugar or honey should be worked in well. Roll out the mixture on a board previously strewn with fine cocoanut, ground nuts or sugar, press out the sweets and roll in sugar. Allow to dry, and store as in the case of the unboiled sweets.

The sweets may also be made in layers; for instance, roll out a layer of figs to a thickness of about ¼ inch, place a layer of ground peanuts, previously well mixed with honey and rolled out to a thickness of ¼ inch, on top, and finally a layer of ground prunes. Roll the three layers together and press out the sweets.

Spices and lemon juice may also be added to the unboiled sweets. By way of variation any fruit sweets may be treated as follows:—(1) dipped into melted fondant; (2) dipped into chocolate; or (3) fondant may be rolled out thinly, and a layer of fruit sweet, about ½ inch thick, be placed between two layers of rolled-out fondant. Roll the layers together and press out the sweets.

As various fruit combinations may be used and the sweets finished in various ways, housewives have a wide choice in making their fruit sweets.—(Union of S.A. Department of Agriculture Press Service.)

Successful Control of Witchweed.

(*Continued.*)

By Rhodesian Farmers.

In the December issue of this journal reports from three farmers on their experiences in the control of witchweed were published. The experience of others is published in the three reports below.

The opinions of these three gentlemen should be of particular interest to their brother farmers since their farms have been in the past as severely infested with witchweed as any in the whole of the maize belt, as many farmers in the Mazoe Valley can vouch.

REPORT No. 4.

By Mr. Edward Bee, Leopard's Vlei.

In reply to your circular of the 9th July regarding witchweed control, I herewith give you my experience as briefly as possible. It was about 1917-18 when I got the first scare on this farm regarding witchweed and I tried carrying it out of the lands and burning it. Even at that time this appeared to be more than could be managed, and as during some wet years just about that time the pest seemed to decrease I, like many others, got it into my head that witchweed was not likely to do the damage in Rhodesia that it does in the Union. From 1926 onwards I had several years alike in that I had a month's drought at almost exactly the same stage of the crop, *viz.*, commencing seven weeks from planting, and it was then 1927 or 1928 when I first saw maize plants withering before the witchweed was through the ground, but in every case it could be found "chitted" on the roots of the withering plant. From that year onwards I saw it at approximately seven weeks from the date of planting. I then felt something must be done and so concentrated on 400 acres of the best lands around the house, and regularly pulled the witchweed and carried it

out of these lands. After two years of this I found the rest of my lands so badly infested that I estimated my loss of crop at 3,000 to 4,000 bags and made up my mind to try to do something to eradicate it from all the lands. This was 1930. I put on nearly 100 natives to pull it out, but as in one land they filled a sack of the weed going only 300 yards up one row of maize that I realised pulling at that stage was out of the question and resorted to hoeing. I hoed all the lands that year for witchweed alone nine to twelve times, commencing directly I had finished hoeing for weeds, and keeping on until I commenced stooking. Even at that time if one had not so many other things to do I am sure it would help to go round once more. I have continued this practice every year since then and have got it down to the stage when 40 natives can keep clear the lands put down to maize, and I estimate that at the present rate of reduction that in a year or two pulling could be resorted to with even less natives than that. I would prefer pulling to hoeing if the infestation was light enough to allow of it. In 1931 and 1932, before my lands felt the benefit of what I was doing, I still estimated my loss at about 3,000 bags per year. Many farmers with whom I have discussed this have been unable to believe the loss could be so great, but this has been amply proved since as, in 1934 I reaped 18,000 bags off 1,060 acres, last year (a very bad year) 11 bags an acre and this year about 21,000 bags off 1,300 acres, and the *visible* damage by witchweed has been practically nil, although I admit there may have been some small loss which was not visible. *There is no doubt, therefore, that the expense has been amply repaid apart from the fact that had I not tackled this matter a good proportion of my lands would by now have been valueless for maize production.*

I have done a good deal of storm draining and found it a help regarding re-infestation, but up to the last year or two the amount of seed in the land has been so great that the small amount coming from the veldt has been a minor consideration; however the cleaner one's lands are from the pest the greater the necessity to prevent infestation from the veldt. The cost of the above work was for the first three years from 80 to 100

natives for about twelve weeks, and this year was 40 natives for a similar period. The labour must be put through the lands at least every fortnight, and it is better to do so every nine or ten days, as after the plant has been cut once or twice it flowers very quickly at the height of only an inch or two. To put boys through the lands with hoes three or four times in the season, as I have heard so many people say they do, is, in my opinion, only doing harm, as it causes the plant to stool and increases the seeding. It has often been put to me by smaller farmers that it has been easy for me to do this owing to the large numbers of natives employed. This, of course, I do not agree with, as it is my experience that small farmers employ more natives per acre than do the large ones, and as their acreage is probably one-third of that of the large farmer, supervision should be easier for them.

I did some trap-cropping for two consecutive years, but gave it up, as even though the trap crop was in each year ploughed in during a lengthy spell of fine weather, it still "poached" the land, so where the spans turned that it was two or three years before the land could be got into nice working condition again and could only be ploughed up with a mouldboard plough. *However, as far as reducing witchweed was concerned, it was a great success*, the pest germinating freely on both the trap-crops used, *viz.*, White Kaffir corn and Amber cane. My sole reasons for abandoning trap cropping were the question of poaching the land when ploughing in, and also that I felt I was getting the upper hand of the pest by hoeing. Finally, I would again stress the point that it is very important if hoeing is to be successful in eradicating witchweed that *it must be hoed out at not longer periods than* 40 *days, and* 10 *day periods are safer.*"

Editorial Note.—Mr. Bee's fight against witchweed is historical in the Mazoe Valley, and his courageous and successful example has had much to do with the fact that amongst the better farmers in the maize belt there is now a note of optimism instead of the almost complete pessimism which reigned about seven or eight years. It should be noted that he has no doubt that this terrible parasite can be controlled by properly supervised hand cultivation.

REPORT No. 5.

By Mr. G. P. Ingram, Collingwood, Concession.

"*Re* your letter of the 9th inst., asking for information about my methods of controlling witchweed.

"I must at once say that I was unable to tackle the problem at the start in what I consider to be the best way, as it took me the best part of two years to convince my landlords of the seriousness of the question and come to suitable terms with them then. I was also, to a great extent, financially handicapped. However, I am now quite convinced that the following methods are, I will not say the best, but very effective.

"Under the headings you mention :—

1. *Storm Drains.*—When the lands are surrounded by hills on which as we all know, or should know, witchweed grows each year and sheds seed, which eventually finds its way to the cultivated areas lying below, storm drains are absolutely essential to prevent it. This also applies to infestation which may come from adjoining farms in storm water.

2. *Hand Cultivation.*—Providing the land is not yet infested to saturation point, by this I mean when the yield is reduced to 1 or 2 bags or less per acre, this method is slow but sure. If you can get 3—6 bags of maize per acre on infested land, I think to spead up the job one should fertilise if possible and practice wide spacing of the lines and closer spacing between plants, so as to get through the lines with a section of springtooth harrow or other suitable implement and two oxen during the whole growing season. This will greatly reduced hand-weeding, which is quite an expensive item, to one-third only. I have carried out the above method this season and find it quite successful. The ideal way is to check-row, but the average small grower often cannot afford the machines or labour for this.

3 *Trap-Cropping.*—Badly infested lands should always be trap-cropped, but the first and most important thing is, I am quite convinced, to give the land a crop of sunnhemp (fertilised if possible) to build up the fertility and so enable it to grow a strong trap crop, which will naturally give a much

heavier germination of this parasite than a poor one. Munga, as you know, has given very promising results here, but I am not prepared to say more until I have carried out further experiments with it, which I intend doing on a fairly big scale this coming season.

As regards improvement of infested land, I have over 200 acres of land, which only gave 4 bags per acre and was hand-weeded thoroughly that year and fertilised with 150 lbs. of supers per acre. In the second year I got a yield of 7 bags per acre. I also got a huge crop of witchweed, which was again dealt with by hand cultivation. In the third year this land was green-cropped with sunnhemp and I have no doubt that this coming season it will yield 10 bags or more per acre.

Now about costs. I must admit that I have not kept separate accounts of this, but as far as I am concerned *I have always done my trap-cropping and hand-weeding with the usual farm labour, and my basis of working is* 6 *boys for every* 100 *acres under cultivation on the farm, irrespective of what crops are grown (tobacco excluded) and that number includes house boys, cattle boys, etc., and I find it can be done quite comfortably.* However, to my mind the real cost or loss, whichever you like to call it, is caused by the reduced yield on lands being dealt with by hand, and no yield at all from lands being trap-cropped; this is very considerable and not easy to estimate. I have no objection to my name being published, and only trust the information given will be of some use.''

Editorial Note.—When Mr. Ingram took over his present farm about four or five years ago the infestation of his fields by witchweed was general and was almost as severe as that on any farm in the Mazoe Valley. He was at that time also financially handicapped. Nevertheless, his report makes it quite clear that he is satisfied that he is steadily overcoming the parasite and in a few years there is no doubt he will have it under effective control. Mr. Ingram had the benefit of his previous experience on Riversdale Estate, where as a section manager he successfully controlled a general infestation by the parasite by hand cultivation. His remarks concerning the costs of control work are a sufficient answer to those who say that this item renders it impracticable and uneconomic.

REPORT No. 6.

By a Farmer in the Mazoe Valley.

"During the season 1927-28 I realised that all was not well with my mealie crop, and on investigation the whole of my land was found to be covered with witchweed. The crop fell from the usual 10 bags per acre and comparative financial security to 3 bags an acre and poverty with bankruptcy looming well in the foreground. 'They' said the first thing to do was drain and contour bank the land, as wash and erosion spreads witchweed. After a lot of thought and scheming to find a royal road to the goal I had in the end to square up to the job and get all drains and contour banks constructed. It didn't prove as expensive as I feared, and ever since I have had good cause to think 'They' were right. Wash on the land accelerated the spread of witchweed more than anything.

I tried different trap crops, green crops and hand hoeing, all with a fair amount of success, and taking into consideration the cheapness of labour of late years and the degree of certainty that other means might possess I have come to the conclusion that hand hoeing is the most suitable method of witchweed eradication for my farm. I find that if the land is in good heart a fair crop of maize can be grown in spite of witchweed. That is a circumstance well in my favour. If badly infested land is well green-cropped and one of the fertiliser firms can be persuaded to give a bit more credit for raw rock phosphate, and that is distributed and well and deeply ploughed in early, *the result is a crop of maize that is a useful trap crop* in that it is a good stand and has a large root system, thereby germinating the maximum quantity of witchweed, and there is my opportunity. I send boys with hoes through it every fortnight with a boss boy and personally see that no overlooking of witchweed plants takes place. Concentration on that bit after green crop or cotton, I have found, reduces the witchweed to reasonable proportions, and once on top of it try to keep there by continuous vigilance

during the growing season. By hoeing every fortnight on reasonably clean land a boy can easily do his acre a day or more. That brings the costs to roughly 6d. per acre per fortnight for the actual killing. Of course, the witchweed must always be hoed before it flowers, otherwise costs are greater in collecting plants for destruction by burning or otherwise. In that way I have brought about, I think, a great deal better propect for the future. My land is producing fairly well—10—12 bags of maize per acre; this year a bit more, and I rather flatter myself that it is due to my efforts that I have not now nearly so much witchweed. Deep ploughing, I think, is a great advantage. I may also say that the maize crops have had to pay for the witchweed killing and keep me going. My cheque book has not had any outside power behind it. To sum up my witchweed adventures and opinions formed in their regard.

1. Erosion spreads witchweed and prevents good ploughing. I think contour banking and ridging has been the main factor in its reduction on this farm.

2. Green cropping and as much raw rock or kraal manure as one can get hold of with the resultant crop of maize as a trap crop which pays for the hoeing out of a well sprouted lot of witchweed.

3. Once the witchweed is reduced see that it does not get another chance in the ensuing years, but keep on top of it.

I have not given trap-cropping much of a trial as I dislike ploughing my land (which is of a greasy nature) when it is wet, and labour has been cheap.

On reading over this product of my own pen I see with surprise that eradicating witchweed is easy and I should laugh at my past fears of the parasite. If I laughed it would not ring true. Getting rid of witchweed is so simple in fact that after eight years' hard going I still find it in quite respectable quantities in the lands, and I have such a respect for it that if I see a patch I have no rest till a span of boys are at it with hoes."

Editorial Note.—This gentleman, who for purely personal reasons prefers to be anonymous, was faced with an alarming situation seven years ago, since all his fields were very severely infested and he was almost despairing of dealing with the situation, but not quite! To-day he is completely certain that he has this terrible menace under control chiefly by hand-cultivation and contour ridging, and his remarks on the latter subject are of particular interest. It may, perhaps, be particularly noted that all three of these gentlemen believe in light surface cultivation of the parasite before it flowers and leaving it on the fields.

Agriculture in the Union of South Africa.

The excellent report of the Secretary for Agriculture and Forestry of the Union of South Africa for the year ended August 31st, 1936, appeared in the December number of *Farming in South Africa.* As this report contains so much material which applies equally well to conditions in this Colony, and since our agricultural interests are so closely concerned with the welfare of agriculture in South Africa, no apology is necessary for referring to the report of the year's work at some length.

The following figures reflect the position of the main branches of farming for the years 1929-30 and 1934-35 :—

	1929-30.	1934-35*
No. of farms in the Union...	96,940	101,277
Area occupied	96,674,076 morgen	99,129,108 morgen
Area under maize (Europeans only)	3,022,279 morgen	3,117,116 morgen
Maize production	22,385,621 bags	18,561,058 bags
Area under wheat	544,064 morgen	1,011,139 morgen
Wheat production	3,187,661 bags	4,912,375 bags
Kaffir corn production... ...	1,769,409 bags	1,380,628 bags
Oat production (in the seed)	2,009,594 bags	1,407,754 bags
Oat production (forage) ...	238,056 tons	110,183 tons
Barley production	704,245 bags	376,750 bags
Potato production	2,308,738 bags	2,257,104 bags
Tobacco production—		
Turkish	1,373,227 lb.	461,683 lb.
Other	10,895,833 lb.	15,806,517 lb.
Peanut production	221,946 bags	176,967 bags
Cattle	10,573,869	10,397,877
Wooled sheep (Europeans)	37,768,977	26,744,842
Non-wooled sheep	4,431,532	5,627,752
Wool production	249,442,062 lb.	186,925,123 lb.
Angora goats	1,800,771	741,752
Other goats	6,199,237	5,255,448
Mohair production	7,019,082 lb.	4,185,052 lb.
Pigs	629,831	523,462

*Preliminary figures for 1934-35 agricultural census.

Dealing with the general question of farming in South Africa Dr. P. R. Viljoen writes:—

Agricultural production is based on four fundamental factors, namely, soil, pasture, crops and live stock, and the key to the successful pursuit of any farming enterprise lies in the establishment of the correct balance between these four major factors.

The Fundamentals of Agricultural Production.—Nature has placed the natural agricultural resources in a very close and delicate relationship and, since agricultural production is after all nothing but the development and utilisation of the natural resources, it is obvious that the farmer has to co-operate intelligently with Nature in order to disturb that balance as little as possible, or, where the nature of his enterprise causes a temporary disturbance, he must ensure that such balance is restored without delay. In other words, the farmer must harness Nature, but in so doing, he must take into account one great universal fact, namely,(that Nature is inexorable and that he *cannot* violate the laws of Nature for any considerable time and expect that his farming operations will emerge unscathed. On the one hand, Nature is willing to give but, on the other, *she demands the restoration of what she has been deprived of.* And this can be achieved only by maintaining the balance between the basic agricultural factors.

Soil is the first factor essential to all forms of agricultural production, and it is thus evident that to maintain such production on a satisfactory level, it is imperative to prevent damage to or impoverishment of the soil. It is a tragic fact, however, that in South Africa, no less than in many other agricultural countries of the world, tremendous damage has already been caused to our agricultural soil, owing to the fact that it has been entirely overtaxed by crop production or live-stock farming, or both. In this connection it cannot be sufficiently stressed that even without cultivation the soil has deteriorated in certain areas, simply because too many cattle have been kept or a proper system of veld management has not been applied.

In other areas, the case is just the reverse, because *too few* cattle are kept. In the natural state, the process is that what is taken from the soil, is again returned to it in the form of decayed plants or manure. Thus, if the soil is used more or less exclusively for the cultivation of crops, the cycle of Nature is not only broken in that the soil is exhausted because no animal manure goes back to it, but the upper layer of fertile soil is also removed gradually.

There is yet another important aspect of this great problem of soil protection, namely, the part played by the vegetal covering. Natural grazing in South Africa is the most important source of stock-feed, and where the vegetation is at the same time also the most important means of soil protection, it is obvious that, especially in drier areas, a great need exists for the maintenance of the correct balance between the use of vegetation for grazing purposes and the requirements of Nature, in order to prevent erosion. And yet it is almost a daily occurrence to come across farms where only the grazing aspect of the natural vegetal covering is concentrated on, while its value as a protector of the soil is entirely disregarded. The harmful effect of such a practice cannot be escaped and a lowering of the carrying capacity of the veld must follow sooner or later. This is, for instance, one of the most important reasons why, in certain districts, the human and animal populations have decreased so much during the past decade.

I realise, of course, that this state of affairs is to a certain extent the outcome of the intensification of our farming industry and that it is no longer an easy matter to prevent the disturbance of the balance between the basic factors under all circumstances. The more intensive agriculture becomes, the greater is the use made of the agricultural resources and the more difficult does it become to avoid a maladjustment or misuse of those resources.

On the other hand, the fact remains that it weakens the whole basis of the industry and that it occasions tremendous losses to our agriculture. It is therefore necessary to set about this problem in a systematic manner with a view to reclaiming the soil that has been lost and preventing further deterioration. This, I consider, can best be accomplished by

establishing the correct balance between the two main branches of agriculture, namely, stock-farming and crop-farming, and by taking steps for the control or elimination of the factors which impede the development of those industries.

The Place of Animal and Field Husbandry in our Agriculture.—I have already voiced the opinion on many occasions that the future of our agriculture lies more in the direction of pastoral pursuits than in that of crop-farming, and this point I wish to stress once more. The reasons are obvious. In the first instance, by far the greatest proportion of the total area of the Union is unsuitable for cultivation on account of its aridness or mountainous topography, and it can thus be used only for grazing purposes. Secondly, the local as well as the oversea demand is more favourable for animal products than for cereals. And thirdly, animals are better able to withstand drought and other adverse climatic conditions than growing crops, which cannot be removed and furthermore cannot be irrigated in most parts of the country, with the result that they cannot escape the disastrous effects of unfavourable climatic conditions.

But in spite of the fact that stock-farming plays, or ought to play, such an important part in our agricultural industry, it is in many respecs not adapted to our natural agricultural resources. I have already focussed attention on one evil, namely, over-stocking. It is not only a major casual factor in severe stock mortality during periods of drought, but it also causes a decrease in production in that it diminishes the production capacity and retards the development of the remaining animals. Indeed, the severe incidence of soil erosion in certain areas and the reduced carrying capacity of such areas are sufficient proof that far too many stock are being kept in some parts. The fact is lost sight of that, by concentrating on quality rather than on quantity, by applying a more rational system of veld management and by utilising supplementary feed in an intelligent manner, the best results can be obtained with stock-farming and the correct balance maintained between the different agricultural resources.

There is also the mistake which is so often made of keeping stock of a quality or type which cannot thrive owing to the poor nutritional value of the veld. If deterioration is to be avoided, it is of the greatest importance to bear in mind

that it is the standard of feeding which determines the nature and quality of the stock. In other words, it is the nutritional value of the veld and not the stock which is the deciding factor.

But in many parts, the quality of the stock must, of course, be improved considerably, and this, moreover, is definitely a practical possiblity when the natural pasture is managed properly, that is, if the correct methods of veld management are employed, and especially if the *natural grazing is supplemented with fodder.* This brings me to the rôle which the provision of fodder should play in our agricultural industry, and at the same time also to the relation between field and animal husbandry. We have seen that the future of our agriculture points in the direction of animal husbandry; we have seen also that stock improvement should go hand in hand with improved feeding; and we all know that there is much room for improving the stock of the Union. It is thus astonishing that, in a country where great surpluses of grain products are usually produced, those products are not used to a greater extent for feeding purposes, with a view to strengthening and improving our stock industry so that it can take its rightful place in our agriculture. In fact, until a few years ago, few farmers fed a portion of their crops to their stock, and even to-day, less than 20 per cent. of our maize production is fed to stock, while in the United States approixmately 85 per cent. of the maize crop does not leave the farms on which it is produced. In addition, the practice of breeding steers in the ranching areas and of sending them to grain areas for fattening purposes is virtually absent in South Africa. The system of fattening animals on the natural veld only, has already resulted in certain areas being overgrazed, in consequence of which the soil has been impoverished in such areas.

In my opinion the time has therefore arrived for a better adaptation of field husbandry to stock-farming, in order to strengthen our stock industry, and to place the feeding side on a level which will ensure that the process of stock improvement is not hampered by a shortage of stock-feed. Any attempt to increase the productivity of our cattle through breeding only, without a corresponding improvement in

feeding, will not bring success. In many parts, cereals and fodder crops must be used not only to ensure uninterrupted growth of the animals during normal times and to prevent loss of condition during periods of scarcity, but, which is equally important, they must also be used as a protection against deterioration of, and as a means of improving the natural veld and soil, which form the basis of the whole stock industry. If the matter is considered from this point of view, which to me is the only correct one, it is obvious that field husbandry is indispensable to the systematic development of the stock industry and the preservation of the productivity of the soil.

Tackling the Problem.—Thus, since there exists between soil, pasture, stock and crops a relationship so close and an interaction so delicate, it is clearly imperative to prevent this chain from being damaged or broken in any respect. And, unfortunately, this most important work has, until recently, been shamefully neglected. I candidly admit this and attach blame to nobody, because economic pressure and circumtancess, perhaps more than anything else, have steered our agricultural policy in a direction which amounts to nothing but the exploitation of our natural agricultural resources, and which, as I have pointed out previously, undermines the strength and resistance of the whole industry. We have ignored the requirements of Nature, and are paying the price; we have broken up the natural "soil-veld-stock" cycle and in so doing have made Nature an enemy instead of a collaborator; in short, through our own short-sightedness, we have taken and have given nothing in return, with the result that, in the end, we have created so many serious and vast problems that the entire foundation of the industry has been threatened. We have, indeed, not only broken the cycle, but we have dislocated the whole process and thus created for ourselves problems which will take years to solve.

Fortunately, however, we have realised our mistake in time, and although we are faced with a formidable task, I have no doubt that through perseverance and devotion we shall emerge triumphantly in the end. What is particularly gratifying is the fact that the farming community is beginning to realise the necessity for a new attitude in that they are showing their willingness to co-operate with the Govern-

ment in order to combat the existing national evils and to restore the natural equilibrium. For the Government on its part is fully determined to make a vigorous effort to eliminate these evils, and to that end extensive State schemes have already been put into operation during the past few years. It is in the interests of the permanent well-being of the whole community that constructive work of this kind be undertaken on as large a scale as possible, for the evils to be eliminated, have assumed such proportions that small-scale measures will not be adequate.

In South Africa, as in all other parts of the world, the importance of pasture research and pasture management has long been recognised and the following extract will be of particular interest to many of our farmers:—

Pasture Research and Veld Management.—In many respects, the natural veld constitutes the most important agricultural asset, as it is virtually the pivot of the "soil-veld-stock" cycle. On the one hand, it is the foundation of soil conservation, and, on the other, it forms the basis of the whole live-stock industry of the Union. It therefore occupies the central position in the chain, whence it influences practically the whole process of agricultural production.

On the present condition of our veld and the extent to which it has deteriorated, I do not wish to elaborate here, since much has already been said and written on the subject. Suffice it to say, that owing to the damage done to the vegetal covering of the veld over a number of years, as a result of over-stocking, injudicious veld-burning, defective veld management, etc., thousands of morgen of valuable veld have deteriorated to such an alarming extent that to-day the carrying capacity of the Union's natural pasture is undoubtedly much lower than it was twenty years ago.

In its endeavour to arrest the processes of deterioration in respect of the basic factors of agriculture, the Department is also giving serious attention to this difficult and weighty problem, as it is fully realised that the protection and improvement of the vegetal covering will not only benefit our live-stock industry considerably, but also eliminate many of the factors which undermine farming.

In essence, this veld-improvement and protection problem is not only of a wide and comprehensive nature, but it is also concerned with fundamental facts and principles which can only be determined by systematic research. Hence, in tackling this problem the Department has made scientific research its starting point, and with this as background it is making every effort to find means of combating the far-reaching effects of veld deterioration.

With this object in view, the grass and veld research work of the Department has been greatly extended during the past few years. Where, until recently, only a few experiment stations devoted special attention to this problem, there is, to-day, practically no research institution under the Department's control where one or more aspects of the problem are not being investigated systematically. Moreover, in order to ensure that the work shall be representative of the numerous grass and veld types found in the Union, new pasture-research stations have been established. This year, for example, new stations have been established at Estcourt and at the Rust-der-Winter irrigation scheme. In short, the full light of science and the research facilities of the Department are focussed on the solution of this burning question.

Undoubtedly, a broad basis for future operations has already been established, which will render possible the gradual inclusion of other aspects of the problem. In the relative annexures to this report, full particulars are given of the work which is being done in this connection, as also of the results so far obtained. These particulars, which reflect the extensive scale on which the problem is being tackled, deserve to be studied by all concerned. The progress made so far, is definitely encouraging, and although work of this nature must necessarily advance slowly, there is every reason to expect that during the next few years it will bear fruit which will pave the way towards the restoration and improvement of the Union's pastures.

The following, however, are a few of the directions of investigation :—

(1) Experiments in connection with the correct methods of veld management and veld reclamation for the different

areas are being carried out at all the pasture-research stations, and the effect on the veld of certain factors such as natural and artificial fertiliser, controlled grazing, rotational grazing, veld-burning, etc., is being closely studied.

(2) At various centres, tests are being undertaken to demonstrate the value of artificial pastures as a means of supplementing the veld during times of scarcity, as well as a means of resting the veld.

(3) In regard to grass-breeding, every effort is being made to breed the most suitable, nutritious and drought-resistant woolly-finger and other grasses through crossing.

(4) The most promising indigenous grasses are being tested out in order to determine their qualities as pasture or ensilage, their nutritional value, their response to fertiliser, etc.

(5) Experiments are being conducted at some of the institutions with a view to breeding grass varieties that can be propagated on a large scale from viable seed.

(6) Experiments are being carried out in connection with the reclamation of steekgras-infested land with a view to benefiting areas where the infestation of old lands with this pest has become an acute problem.

(7) The special requirements relative to the conservation and propagation of our indigenous shrubs, and more especially our Karroo bushes which play such an important rôle in a large part of the country, are receiving particular attention.

This is sufficient to indicate the use that is being made of ecological science in connection with this work, and that this research work embraces not merely certain phases of the problem but covers the entire field; that is to say, problems ranging from those of a purely botanical nature to the every-day veld problems of the farmer are carefully dissected.

Concurrently with this fundamental research work, the Department has caused a large number of co-operative demonstration plots to be established on farms in all the provinces. These demonstration plots answer a dual purpose, *viz.*, to test out indigenous grasses suitable for the different areas and to demonstrate to farmers the best methods of

treating and propagating the varieties. This is one of the most effective methods of bringing the farmer into direct contact with the results of the research work carried out at the experiment stations, and also of making propaganda for the practical application of such results.

This work has reached an advanced stage, inasmuch as extension officers, under whose control these demonstration plots have been placed, are already in a position to recommend, with a fair degree of certainty, the pasture grasses best suited to their respective areas. It is the intention, funds permitting, to extend such plots as have proved a success, so that the establishment of pastures and the advantages attaching to proper grazing systems can be demonstrated to farmers on a scale that will be more in accord with the conditions obtaining on the average farm. In this way, farmers will be afforded the unique opportunity of seeing for themselves what can be done to improve their pastures and how to bring such pastures up to and maintain them at a proper level of efficiency.

The experiment stations are also being used to bring home to the farming community the value of veld maintenance and veld improvement. It is encouraging to note that farmers are becoming more and more alive to the fact that veld deterioration is a national evil which must be fought tooth and nail, and these experiment stations are utilised not merely to obtain authentic data in connection with the fundamental veld and grazing problems, but, as such data become available, it is also their duty to enlighten farmers, in the vicinity as well as those in areas where similar conditions obtain, as to the best methods to be employed in preventing or combating this evil. Indeed, although the guidance they can afford at this stage is of necessity still restricted to the most conspicuous abuses, these stations are nevertheless intended to play an important rôle later on, in the general campaign against veld deterioration. That they will be eminently suitable for this purpose cannot be denied, as not only will they have at their disposal the necessary scientific data which will form the basis of the systematic, long-term work, but they will also serve as centres where farmers may obtain immediate assistance and advice concerning their individual difficulties in regard to the protection, conservation and improvement of their veld.

In regard to the whole question of establishing artificial pastures, it should be pointed out, however, that this matter is very closely associated with the climatic and soil conditions obtaining in the various parts of the Union, and it is obvious, therefore, that it is only a practical possibility where such conditions are favourable. Actually the possibilities for laying down artificial pastures are limited in many parts of the Union, and in such parts, more than in any other, proper veld management is imperative. In the practical application of this policy, it is therefore essential that the areas where artificial pastures can be established successfully, should be selected carefully.

In view of the unfavourable climatic conditions prevailing in many parts, it may perhaps be desirable to promote pasture establishment under irrigation, but it still remains to be seen whether it would be an economic proposition. In any case, experiments to determine the possibilities of pasture establishment under irrigation are at present in progress, and the results will show what can be done in this direction. In countries like Australia, for example, it is the general practice to grow fodder crops under irrigation, especially lucerne for stock-feed, but whether this will be an economic proposition in the case of grass, cannot be stated at this stage.

Proper Feeding.—Although the cattle-improvement scheme, introduced in terms of the Stock and Meat Industries Act (1934) has not yet been in operation for fully two years, a great deal has been done during that short period to increase the productivity and efficiency of our cattle, and the fact that the drought has not occasioned greater losses among stock, must to a certain extent be ascribed to the work accomplished in this field.

At the same time, the application of the cattle-improvement scheme has revealed that there are two main questions on which we must concentrate to achieve our ultimate aim. The first is feeding and the second is breeding.

Feeding has purposely been placed first, for, as I have already pointed out previously, proper feeding should precede breeding and not follow it. There is actually a great danger that our efforts in respect of improved breeding will be

nullified to a large extent, unless at the same time improved methods of stock and veld management are applied, provision is made for sufficient feed during periods of drought and scarcity, and the grazing is protected and used judiciously. That a great deficiency still exists in this respect, cannot be denied, and as I view the matter, it is to-day the greatest retarding factor in the development of a strong and sound cattle industry in the Union. It is important to refer here to the view expressed by the Departmental Committee on Meat Export.

In regard to the feeding problem they reported as follows:—

"While breeding will have to play an important part it is felt that the availability of supplies for the future is largely a question of feeding. This aspect is of outstanding importance. In certain areas grass-fed animals suitable for chilled beef export can be raised when conditions are favourable, but this does not and will not assure continuity of supplies because of variable climatic conditions. In most cattle areas of the Union grass-fed animals are rarely suitable for chilled beef export. Until such time as the feeding of concentrates becomes an established practice, the Union will be faced with difficulties in obtaining regular supplies of animals suitable for chilled beef export. Palpably the level of improvement attained under any system of improved cattle breeding will remain low unless associated with a higher level of feeding than obtains at present. Supplementary feeding is essential in assuring availability of supplies for the chilled beef trade."

It will therefore be mere shortsightedness to apply injudiciously a policy of improved breeding in a country like South Africa with its great diversity of grazing conditions. Besides, there are relatively few cattle farmers, who practise a system in which the natural grazing is supplemented by concentrates, and who have made the systematic care of stock a permanent feature of their enterprise. Much educational work remains to be done in this field, and this is therefore an aspect of the problem to which the animal husbandry and extension officers of the Department are devoting special attention, because it will be disastrous to recommend to farmers, without further

education and enlightenment, a breeding level, which is far above the average level obtaining in most parts of the country and also beyond the means of the average farmer.

In addition, research work is being carried out at various centres in order to collect more data on certain fundamental feeding problems. To mention only a few directions of investigation:—(*a*) A series of experiments have been started with a view to ascertaining to what extent the natural grazing in the different stock areas should be supplemented by fodder to prevent a set-back in growth and development, as well as what fodder varieties are the most economical and effective for this purpose. (*b*) Fattening experiments are in progress to determine the best rations and concentrates for finishing-off steers.

Southern Rhodesia Weather Bureau.

NOVEMBER, 1936.

Pressure and Temperature.—The mean monthly pressure was about normal, but temperatures, probably on account of the rainfall, well below normal at most stations.

Rainfall.—The rainfall was generally in excess in all areas, the average for the country being 1.8 inches above normal. The rainfall at Bulawayo, 8.72 inches, is the highest recorded for that station in 40 years.

NOVEMBER 1936.

Station.	Pressure Millibars, 8.30 a.m. Mean.	Pressure Normal.	Temperature in Stevenson Screen °F. Absolute Max.	Absolute Min.	Mean Max.	Mean Min.	Mean ½ Max. Min.	Mean Normal.	Dry Bulb.	Wet Bulb.	Rel. Hum. %	Dew Point F.	Cloud Amt. 0-10	Precipitation Ins.	Precipitation Normal	No. of Days	Altitude (Feet)
Angus Ranch... ...	...	...	103	61	89.1	68.6	78.9	79.7	78.2	68.4	61	64	...	5.41	1.84	9	...
Beitbridge...	963.6	...	103	62	88.4	67.9	78.1	...	76.0	67.3	65	63	6.5	1.12	2.14	8	1,500
Bindura...	891.5	...	94	61	82.9	65.2	74.1	...	72.1	64.7	68	60	5.4	4.10	2.93	15	3,700
Bulawayo	869.1	869.2	94	53	81.7	59.5	70.6	72.6	70.1	61.8	56	57	5.3	8.72	3.29	14	4,393
Chipinga	892.3	...	91	53	79.0	61.2	70.1	...	71.5	64.2	70	60	5.2	5.56	4.18	15	3,685
Enkeldoorn...	857.4	...	92	54	80.2	59.4	69.8	72.0	69.8	62.0	67	58	5.0	4.92	3.37	15	4,788
Fort Victoria	895.2	895.2	99	55	83.4	62.3	72.9	72.7	72.8	64.3	65	59	5.4	5.90	2.89	12	3,571
Gwaai Siding	903.1	...	101	56	90.5	63.3	76.9	...	76.4	65.6	58	59	4.3	3.75	2.29	11	3,278
Gwanda...	905.9	...	101	54	85.2	62.4	73.8	...	73.2	64.6	65	60	5.1	5.63	2.16	9	3,233
Gwelo	862.1	...	94	54	80.9	59.9	70.4	73.6	69.2	61.9	68	57	4.2	7.79	3.66	11	4,629
Hartley...	885.1	...	94	56	83.9	62.4	73.2	76.4	73.3	64.1	63	58	5.2	5.71	3.53	17	3,879
Inyanga...	837.1	...	83	51	75.9	56.7	66.3	...	68.6	60.8	66	57	4.8	7.04	3.74	17	5,503
Marandellas	837.8	...	86	53	77.0	58.6	67.8	...	67.3	60.1	68	56	6.5	4.72	3.89	17	5,453
Miami	878.6	...	93	56	83.0	63.0	73.0	...	71.4	63.4	66	58	5.8	1.18	2.33	7	4,090
Mount Darwin ...	907.2	...	97	59	86.5	65.4	75.9	..	74.5	66.4	68	62	5.4	4.96	3.28	8	3,179
Mount Nuza	802.5	...	76	47	65.1	53.2	59.1	...	59.5	56.5	85	54	7.3	8.39	8.44	23	6,668
Mtoko	877.2	...	91	60	81.2	63.8	72.5	...	71.8	63.9	67	59	5.5	...	3.31	...	4,141
New Year's Gift...	...	...	97	57	85.0	63.1	74.1	...	75.2	65.9	61	61	...	3.09	3.03	11	2,690
Nuanetsi	961.0	...	104	60	89.0	65.9	77.4	...	76.4	67.6	65	63	6.0	1.59	2.13	8	1,581
Plumtree	863.9	...	96	55	83.1	62.2	72.7	...	71.6	61.5	59	55	4.9	5.32	2.82	12	4,549
Que Que	881.7	...	95	56	83.8	62.4	73.1	...	71.4	63.4	66	58	5.3	4.65	2.66	13	3,999
Rusape	862.2	...	90	53	79.4	59.6	69.5	...	69.1	61.8	68	57	5.3	6.78	4 66	15	4,648
Salisbury	856.3	856.2	91	56	80.5	60.3	70.4	71.9	69.6	61.5	65	57	5.7	3.80	3.55	13	4,831
Shabani...	909.4	...	101	57	84.9	64.0	74.5	...	73.7	65.2	65	61	4.3	5.07	1.55	12	3,131
Sinoia	888.1	...	95	54	85.1	62.2	73.7	...	73.7	64.5	63	59	4.9	3.41	3.31	16	3,795
Sipolilo	885.0	...	92	60	82.9	64.6	73.8	...	73.5	65.0	65	60	5.0	4.31	3.26	11	3,876
Stapleford	842.4	...	83	46	71.6	55.3	63.5	...	64.9	60.7	80	58	7.0	9.11	5.97	21	5,304
Umtali...	892.7	892.9	98	57	82.3	62.4	72.3	72.6	70.9	64.6	73	61	6.8	6.65	3.77	16	3,672
Victoria Falls... ...	910.9	...	104	60	94.2	66.0	80.1	...	78.4	67.1	57	61	3.0	5.38	2.59	12	3,009
Wankie	925.5	...	105	62	95.7	71.8	83.7	...	81.8	68.3	52	62	5.3	1.59	1.94	9	2,567

Rainfall in November, 1936, in Hundredths of an Inch. Telegraphic Reports.

Area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total	Normal
1	...	...	...		...	...	...	...	21	42	26	87	1	2	...	76	66	72	33	1	...	55	12	1	...	...	...	14	2	1	512	276
2	...	...	...	...	...	...	...	5	...	34	36	9	34	51	1	40	69	37	25	...	14	128	1	10	1	...	...	1	88	5	589	266
3	2	...	...	...	...	...	...	1	...	...	...	...	4	11	20	22	100	60	66	2	...	121	2	47	21	3	...	...	103	17	602	449
4	...	...	...	...	...	...	...	1	12	13	23	14	8	24	1	52	69	47	62	14	5	164	...	18	8	...	...	43	85	3	666	341
5	...	...	5	...	...	...	...	...	24	5	35	24	11	3	6	8	13	31	127	4	...	50	5	...	...	...	3	29	15	12	410	245
6	...	...	...	...	...	...	...	5	...	41	16	68	9	14	11	6	6	2	66	8	22	100	...	6	4	25	...	17	2	...	428	355
7	4	6	...	...	...	...	...	5	...	...	...	41	89	13	1	32	15	60	96	14	14	60	21	52	30	23	4	59	31	11	681	429
8	..	3	...	...	...	...	...	1	...	...	...	...	15	...	13	24	3	88	49	10	1	55	21	22	2	52	...	12	16	4	391	363
9	...	...	...	...	...	...	4	7	4	...	3	...	8	22	37	7	19	25	38	3	...	78	14	5	1	12	...	23	6	...	316	311
10	...	...	...	...	...	...	...	...	...	...	...	...	...	16	...	...	...	161	39	4	...	13	83	120	...	11	...	...	7	...	454	329
Mean	...	1	1	...	...	...	1	3	9	19	19	34	19	16	8	30	34	48	62	5	6	80	12	17	5	9	1	22	27	5	493	311

Southern Rhodesia Veterinary Report.

OCTOBER, 1936.

AFRICAN COAST FEVER.

Disease diagnosed on farm Bok Kraal, Melsetter district.

MALLEIN TEST.

Thirty-one horses and forty donkeys upon entry. No reaction.

TUBERCULIN TEST.

Two bulls and 40 cows, with negative results.

IMPORTATIONS.

From Union of South Africa.—40 cows, 22 bulls, 18 horses and 747 sheep.

From Bechuanaland Protectorate.—13 horses, 40 donkeys and 517 sheep.

EXPORTATIONS.

To Union of South Africa.—442 oxen, 18 cows, 1 horse and 39 pigs.

EXPORTATIONS—MISCELLANEOUS.

To United Kingdom in Cold Storage.—Chilled beef quarters, 5,825; frozen boned beef quarters, 4,472; frozen beef quarters, 11,903; frozen boned veal sides, 88; kidneys, 5,033 lbs.; tongues, 13,448 lbs.; livers, 21,642 lbs.; hearts, 1,441 lbs.; tails, 2,266 lbs.; skirts, 4,016 lbs.; shanks, 17,726 lbs.

Meat Products.—From Liebig's Factory: Corned beef, 43,320 lbs.; meat extract, 24,586 lbs.; beef powder, 93,828 lbs.; beef fat, 24,000 lbs.; meat meal, 60,000 lbs.

G. C. HOOPER SHARPE,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-36.

Monthly Report No. 48, November, 1936.

Swarms of the Red Locust (*Nomadacris septemfasciata*, Serv.) have been reported from the following districts during the month, namely:—Mazoe, Makoni, Mrewa, Inyanga, Umtali, Melsetter, Marandellas, Charter, Chilimanzi, Bikita, Gutu, Victoria, Gwelo, Insiza, Chibi, Ndanga, Gwanda and Wankie.

Most of these swarms have been described as "large."

With the exception of the appearance of one or two swarms in the Mazoe district at the end of the month, the position has shown little change since October.

No specimens with developed ovaries had been received at headquarters and oviposition would appear not to be imminent.

A few specimens infested with maggots were received from the Inyanga district.

Damage to maize was reported in the Umtali district.

With regard to the outlook it may be stated that whilst invasion by swarms nearing breeding condition has not yet occurred, the possibility of a late invasion of this nature cannot be ignored. Eggs were laid mainly from January to March during the 1935-36 season. On the whole, however, the prospects for the growing season are at present favourable.

RUPERT W. JACK,
Chief Entomologist.

Departmental Bulletins.

The following Bulletins are available for distribution at 3d. per copy. Application should be made to the Editor, Department of Agriculture, Salisbury, and remittances must accompany orders.

N.B.—The date the article appeared in the Journal is indicated in abbreviated form before the number, e.g., 8/22, No. 429, means that Bulletin 429 appeared in the Journal for August, 1922.

AGRICULTURE AND CROPS.

7/25. No. 545. Artificial or Synthetic Farmyard Manure, by H. G. Mundy, Dip.Agric., F.L.S.

3/27. No. 630. The Storage of Seed Potatoes, by H. C. Arnold.

5/27. No. 643. Noxious Weeds in Southern Rhodesia, by F. Eyles, Botanist.

12/27. No. 663. The Use of Fertilisers and Manures in Southern Rhodesia, by A. D. Husband, A.I.C., Chief Chemist.

2/28. No. 672. Hay-making in Rhodesia, by H. G. Mundy, Dip.Agric., F.L.S.

2/28. No. 674. Top Dressing of Maize against Stalk Borer, by H. C. Arnold.

3/28. No. 681. The Sunflower (Helianthus Annuus) (Revised), by S. D. Timson, M.C., Dip.Agric.

6/28. No. 694. The Edible Canna (Canna Edulis), by D. E. McLoughlin.

6/28. No. 695. The Castor Oil Plant (Ricinus spp.), by S. D. Timson, M.C., Dip.Agric.

9/28. No. 705. Suggested Cropping Programmes for Farms on the Sand Veld, by D. E. McLoughlin, Assistant Agriculturist.

9/28. No. 706. A Farmers' Calendar of Crop Sowings, by C. Mainwaring, Agriculturist.

10/28. No. 710. Monthly Reminders for the Farming Year, by the Division of the Chief Agriculturist.

3/29. No. 727. Farmyard Manure, by A. P. Taylor, M.A., B.Sc., Agricultural Chemist.

3/29. No. 732. Two Common Diseases of Potato Tubers in Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.

7/29. No. 743. Sunn Hemp, by S. D. Timson, M.C., Dip.Agric.

9/29. No. 751. The Sweet Potato, by S. D. Timson, M.C., Dip.Agric. (Wye).

10/29. No. 758. Instructions for Taking Soil Samples. Issued by the Division of Chemistry.

1/30. No. 768. The Ground Nut (Arachis hypogaea), by S. D. Timson, M.C., Dip.Agric. (Wye).

3/30. No. 776. Regulations Governing the Export of Maize and Maize Meal through the Port of Beira.

11/30. No. 797. Green Manuring: An Essential Practice in Rhodesian Farming, by H. G. Mundy, Dip.Agric. (Wye), F.L.S., Chief Agriculturist.

1/31. No. 802. Witch Weed, by S. D. Timson, M.C., Inter.B.Sc. (Agric.) London., Dip.Agric (Wye), Assistant Agriculturist.

3/31. No. 815. New Strains of Oats for Southern Rhodesia, by H. C. Arnold, Manager, Agricultural Experiment Station, Salisbury.
4/31. No 816. Preliminary List of the more Common Grasses of Southern Rhodesia, by Sydney M. Stent, Botanist for Pasture Research.
5/31. No. 822. Re-stacking of Maize rejected for Export on account of Excessive Moisture.
9/31. No. 826. Some Poisonous Plants of Southern Rhodesia, by Sydney M. Stent, Senior Botanist.
10/31. No. 831. Revised Notes on Cotton Growing in Southern Rhodesia, by G. S. Cameron.
11/31. No. 836. The Potato, by S. D. Timson, M.C., Dip.Agric. (Wye).
12/31. No. 837. Veld Grass Silage: A Feature in Rhodesian Pasture Management, by H. G. Mundy, Dip.Agric. (Wye), F.L.S., Chief, Division of Plant Industry.
1/32. No. 841. Poisonous or Suspected Poisonous Plants of Southern Rhodesia: Tulip Poisoning of Cattle, by Sydney M. Stent, Senior Botanist, and D. A. Lawrence, B.V.Sc., Veterinary Research Officer.
6/32. No. 855. Pigeon-hole Method of Stacking Maize, by Division of Plant Industry.
8/32. No. 859. Twenty-one Years of Plant Introduction, by Major Mundy, Chief Division of Plant Industry.
2/33. No. 878. A.I.V. Silage: Memorandum prepared and circulated by Imperial Bureau of Animal Nutrition.
11/34. No. 936. Witchweed, by S. D. Timson, M.C. Dip.Agric. (Wye), Assistant Agriculturist.
10/35. No. 970. Rhodes Grass for the Southern Rhodesian Tobacco Grower, by African Explosives and Industries, Ltd.
11/35. No. 972. Notes on Witchweed, by S. D. Timson, M.C., Dip.Agric. (Wye), Assistant Agriculturist.
2/36. No. 978. Organic Manure in Relation to Wheat Growing in Rhodesia: Its Importance and How to Produce It, by S. D. Timson, M.C., Dip.Agric. (Wye), Assistant Agriculturist.
3/36. No. 982. Weeds: Control of Weeds on Footpaths and Tennis Courts, by S. D. Timson, M.C., Assistant Agriculturist.
6/36. No. 992. Annual Report of the Agriculturist for the year 1935, by D. E. McLoughlin, Agriculturist.
7/36. No. 994. Some Notes on Cotton Growing, by J. E. Peat, Senior Plant Breeder, Cotton Station, Gatooma.

REPORTS ON CROP EXPERIMENTS.

7/27. No. 649. Annual Report of Experiments, 1925-26, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Manager.
4/28. No. 683. Annual Report of Experiments, 1926-27, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Station Manager.
7/29. No. 745. Salisbury Agricultural Experiment Station Annual Report, 1927-28, by H. C. Arnold.
7/30. No. 789. Agricultural Experiment Station, Salisbury. Annual Report of Experiments, 1928-29, by H. C. Arnold.

9/31. No. 830. Salisbury Agricultural Experiment Station, Annual Report, 1929-30, by H. C. Arnold, Manager.

10/32. No. 864. Annual Report, 1930-31: Agricultural Experiment Station, by H. C. Arnold, Station Manager.

6/33. No. 895. Salisbury Agricultural Experiment Station Annual Report, 1931-32, by H. C. Arnold, Manager.

3/34. No. 914. Gwelo Municipal Demonstration Station: Final Report, 1933, by S. D. Timson, M.C., Dip.Agric. (Wye), Assistant Agriculturist.

9/35. No 965. Salisbury Agricultural Experiment Station Annual Report, 1933-34, by H. C. Arnold, Manager.

TOBACCO.

8/26. No. 605. Flue-curing Tobacco Barns, Bulking and Grading Sheds, by P. H. Haviland, B.Sc. (Eng.), Acting Government Irrigation Engineer.

9/26. No. 615. The Culture of Virginia Tobacco in Southern Rhodesia: Field Management, by D. D. Brown.

5/27. No. 641. The Handling, Grading and Baling of Cured Virginia Tobacco, by D. D. Brown.

5/27. No. 644. Tobacco Baling Boxes, by B. G. Gundry, Irrigation Branch.

9/27. No. 653. The Care of Tobacco Seed Beds, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad)

11/27. No 661. Flue-curing Tobacco Barns, 12 ft. x 12 ft. x 16 ft., by B. G. Gundry.

1/28. No. 665. Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.

2/28. No. 671. Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.

12/28. No. 715. Turkish Tobacco Culture in Southern Rhodesia, by D. D. Brown, Chief Tobacco Expert.

3/29. No. 728. Suggested Crop Rotations for Tobacco Growers, by D. D. Brown, Chief Tobacco Expert.

4/29. No. 734. Common Faults in Curing Virginia Bright Tobacco, by D. D. Brown, Tobacco and Cotton Expert.

8/29. No. 748. Frog Eye Disease of Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

9/29. No. 753. Leaf Spotting of Tobacco caused by Mosaic, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

2/30. No. 771. Dark Fire-cured Tobacco: Field Operations, by D. D. Brown, Chief Tobacco Expert.

3/30. No. 774. Dark Fire-cured Tobacco: Harvesting and Curing, by D. D. Brown, Chief Tobacco Expert.

6/30. No. 784. Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.

3/31. No. 812. Selection of Tobacco Seed Plants, by H. F. Ellis, M.Sc., B.S. (Agric.), Tobacco Adviser.

9/31. No. 828. Seed Beds, by D. D. Brown, Chief Tobacco and Cotton Expert

11/31. No. 835. Tobacco Culture: Transplanting Operations, by D. D. Brown.

3/32. No. 846. Leaf Curl in Tobacco, by Dr. H. H. Storey.

3/33. No. 885. Tobacco Culture in Southern Rhodesia: The Harvesting and Curing of Virginia Tobacco, by D. D. Brown, Chief Tobacco Officer.

8/36. No. 996. The "Gundry" Tobacco Furnace, by B. G. Gundry, A.I.Mech.E.

12/36. No. 1009. Tobacco Research on the Trelawney Station 1935-36 Season.

LIVE STOCK.

1/27. No. 624. The Construction of Dipping Tanks for Cattle (Revised).

6/30. No. 785. Bacon Curing on the Farm, by T. Hamilton, M.A., N.D.A., N.D.D., Dairy Expert.

1/31. No. 801. Sheep Farming in the Melsetter District, by J. C. Kruger, Part-time Sheep Adviser in the Melsetter District.

10/32. No. 863. Piggeries, by B. G. Gundry, A.I.Mech.E.

12/32. No. 871. Some General Observations on the Feeding of Dairy Cows on a Mixed Stock Farm, by Dr. A. E. Romyn, Senior Animal Husbandry Officer.

1/33. No. 873. The Hand-rearing of Calves, by C. A. Murray, B.Sc. (Agric.), M.Sc.

4/33. No. 887. The Type of Chiller Steer required for Export, by A. E. Romyn, Senior Animal Husbandry Officer.

5/33. No 891 Fattening Bullocks for Export, by A. E. Romyn, Senior Animal Husbandry Officer.

9/33. No. 903. The Handling, Preparation and Chilling of Cattle for Export, by C. A. Murray, Lecturer in Animal Husbandry.

12/33. No. 907. The Blackhead Persian: Its Breeding and Management in Matabeleland, by C. A. Murray, M.Sc., Lecturer in in Animal Husbandry, Matopo Estate.

1/34. No. 909. Stall Fed Chillers for the Overseas Christmas Market, by C. A. Murray, M.Sc., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.

2/34. No. 912. Economical Winter Rations for Wintering Dairy Heifers, by C. A. Murray, M.Sc. (Agric), Lecturer in Animal Husbandry, Matopo School of Agriculture.

4/34. No. 916. Cowpea Hay in the Ration for Bacon Pigs, by C. A. Murray, M.Sc. (Agric.), Lecturer in Animal Husbandry, Matopo School of Agriculture and Experiment Station.

5/34. No. 919. Saltbush: A Winter Succulent for Sheep in Matabeleland, by D. G. Haylett, M.Sc., Ph.D., Director, Matopo School of Agriculture.

6/34. No. 924. Raising Dairy Calves on a Limited Amount of Whole Milk, by C. A. Murray, M.Sc., Agr., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.

1/35. No. 943. Cattle Improvement and a Cattle Breeding Policy in Southern Rhodesia: A Review of the General Position Chiefly as regards Ranching Cattle, by Dr. A. E. Romyn, Chief Animal Husbandry Officer.

1/35. No. 944. Pig Feeding Demonstration: The use of Balanced and Unbalanced Rations for Growing Pigs, by C. A. Murray, M.Sc. (Agr.), Senior Animal Husbandry Officer I/C., Matopo School of Agriculture and Experiment Station.

1/35. No. 945. A Home-made Cow Stanchion, by Major R. R. Sharp, Whinburn, Redbank.

3/35. No. 946. Economical Rations for Wintering Dairy Cattle, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station.

5/35. No 952. Annual Report of the Chief Animal Husbandry Officer for the year ending 31st December, 1934, by A. E. Romyn, Chief Animal Husbandry Officer.

7/35. No. 959. The Selection of a Dairy Bull, by A. E. Romyn, Ph.D., Chief Animal Husbandry Officer.

3/36. No. 981. The Dehorning of Cattle intended for Slaughter and Export, by B. A. Myhill, Assistant Chief Veterinary Surgeon.

4/36. No. 984. Report on the Curing of Rhodesian Hides, by Advisory Committee on Hides and Skins of the Imperial Institute.

4/36. No 985. Export of Frozen Porkers. Third Consignment to Smithfield. Division of Animal Husbandry.

5/36. No. 987. The Curing of Hides and Skins on the Farm, by The Division of Animal Husbandry.

5/36. No. 988. Preparing Cattle for Show, by The Animal Husbandry Division.

6/36. No. 989. The Supplementary Feeding of Mineral and Protein Supplements to Growing Cattle in Southern Rhodesia and its Relation to the Production of Beef Steers, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E. Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Southern Rhodesia; D. G. Haylett, Ph.D., Director, Rhodes Matopo Estate; F. Ericksen, Dip. Agric., Experimentalist.

10/36. No. 1001. The Raising of Bacon Pigs, by A. E. Romyn, Chief Animal Husbandry Officer, and C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate, with a Veterinary Section by D. A. Lawrence, Director of Veterinary Research.

9/36. No. 1000. Sheep Management on the Mixed Farm, by R. H. Fitt, Animal Husbandry Officer.

DAIRYING.

1/28. No. 667. Farm Cheese-making, by T. Hamilton, M.A., N.D.A., N.D.D., Dairy Expert.

3/29. No. 730. Common Defects in Butter-making, by T. Hamilton, M.A., N.D.A., N.D.D., and J. R. Corry, B.Sc. (Agr.), Dairy Experts.

12/30.	No.	799.	The Objects of Ripening Cream for Butter-making, and a few Hints on Cream Production, by F. Lammas, Dairy Officer.
4/31.	No.	818.	Farm Butter-making. Issued by the Dairy Branch.
9/32.	No.	862.	Cream Cheese, by F. A. Lammas, Dairy Officer.
3/33.	No.	880.	Dairy Tests and Calculations, by F. A. Lammas, Dairy Officer.
5/34.	No.	922.	Dairy Building in Southern Rhodesia: A Small Farm Dairy, by G. B. Gundry, A.I.Mech.E.
7/34.	No.	926.	Dairy Buildings in Southern Rhodesia. Cow Byre—Type II., by B. G. Gundry, A.I.Mech.E.
12/34.	No	937.	Gouda or Sweet Milk Cheese, by F. Lammas, District Dairy Officer.
2/36.	No.	977.	Notes on the Feeding of Dairy Cows during the Summer Months, by A. E. Romyn, Chief Animal Husbandry Officer.
6/36.	No.	990.	Southern Rhodesia Milk Recording Scheme.

VETERINARY.

10/14.	No.	191.	Scab or Scabies in Sheep and Goats, by Rowland Williams, M.R.C.V.S.
4/25.	No.	536.	Inoculation of Cattle against Redwater and Gall Sickness, by Ll. E. W. Bevan, M.R.C.V.S.
12/25.	No.	570.	The Spaying of Bovines, by G. C. Hooper Sharpe, M.C., M.R.C.V.S., and M. H. Kingcombe, M.R.C.V.S.
6/26.	No.	597.	Suspected Poisoning of Stock: The Proper Procedure, by M. H. Kingcombe, M.R.C.V.S. (Lond.), and A. W. Facer, B.A. (Oxon.), A.I.C.
12/26.	No.	618.	Notes from the Veterinary Laboratory: Quarter Evil, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.
1/28.	No.	666.	Notes from the Veterinary Laboratory: Praemonitus—Praemunitus, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.
4/29.	No.	739.	The Laboratory Diagnosis of Animal Diseases: A Note to Emphasise some Points in the Preparation and Forwarding of Specimens, by D. A. Lawrence, B.V.Sc., Veterinary Research Officer.
10/29.	No.	756.	Parasitic Gastritis of Cattle, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.
11/29.	No.	760.	A Note on Sheep Diseases in Southern Rhodesia, by D. A. Lawrence, B.V.Sc., Veterinary Research Officer, Department of Agriculture, Salisbury.
2/30.	No.	772.	Notes from the Veterinary Laboratory: Ophthalmia, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.
4/31.	No.	819.	Measles in Swine, by P. D. Huston, M.R.C.V.S.
10/32.	No.	866.	The Treatment of Intestinal Parasites of Sheep, by J. D. Coutts, D.V.S., M.R.C.V.S.
4/33.	No.	886.	A Preliminary Note on Contagious Granular Vaginitis in Southern Rhodesia, by D. A. Lawrence, B.V.Sc., Acting Director Veterinary Research.

5/34. No. 921. Myiasis (Screw-Worm) in Cattle in Southern Rhodesia, by D. A. Lawrence, Director of Veterinary Research, and A. Cuthbertson, Entomologist.

IRRIGATION, WATER SUPPLIES AND SOIL EROSION.

3/27. No. 633. The Cost of Pumping for Irrigation, by R. H. Roberts, B.Sc. (Eng.).

4/27. No. 640. Levelling for Irrigation, by Dr. W. S. H. Cleghorn, M.I.Mech.E.

11/27. No. 659. The Hydraulic Ram, revised by P. H. Haviland, B.Sc.

11/27. No. 660. Small Earthen Storage Reservoirs, by C. L. Robertson, B.Sc.

11/28. No. 668. The Water Act, 1927, by C. L. Robertson, B.Sc. (Eng.), A.M.I.C.E.

1/28. No. 670. Irrigation Canals, by P. H. Haviland, B.Sc. (Eng.).

5/30. No. 782. Reinforced Concrete Water Tanks, by R. Hamilton Roberts, B.Sc. (Eng.).

6/30. No. 786. Low Concrete Dams, by R. Hamilton Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

2/31. No. 808. The Application of Water in Irrigation, by R. Hamilton Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

3/31. No 811. Irrigation Canal Structures, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

8/32. No. 860. Soil Drainage and Utilisation of Vleis, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

2/33. No. 879. Conditions Governing the Hire of Government Boring Machines.

8/33. No. 900. Three Types of Water Tank, by R. H. Roberts, B.Sc. (Eng.), A.M.I.C.E., Assistant Irrigation Engineer.

6/34. No 923. Soil Eroison, by P. H. Haviland, B.Sc. (Eng.), A.M.I.C.E., Irrigation Engineer (Matabeleland).

6/35. No. 956. Annual Report of the Division of Irrigation for the year ended 31st December, 1934, by P. H. Haviland, B.Sc. (Eng.), Acting Chief Irrigation Engineer.

9/35. No. 964. The Use of Ditchers for Constructing Contour Ridges, by C. Tapson, Devondale, Concession.

9/35. No. 967. How to use an Engineer's or Farm Level, by P. H. Haviland, B.Sc. (Eng.), A.M.I.C.E., Irrigation Engineer (Matabeleland).

12/35. No 973. Domestic Water Supplies and Sanitation on the Farm, by P. H. Haviland, B.Sc. (Eng.), A.M.I.C.E.. Irrigation Engineer (Matabeleland).

3/36. No. 980. Results from Glenara Soil Conservation Experiment Station, 1934-35 Season, by C. L. Robertson, B.Sc. A.M.I.C.E., Chief Engineer, Irrigation Division, and A. D. Husband, F.I.C., Chief Chemist.

8/36. No. 999. Lining an Irrigation Furrow, by R. H. Roberts, B.S.. A.M.Inst.C.E., Assistant Irrigation Engineer.

FORESTRY.

1/26. No. 575. Tending of Eucalyptus Plantations, by A. S. Thornewill, B.A.

11/29. No 763. The Utilisation of Wood, by T. L. Wilkinson, M.Sc., B.Sc.F.

1/30. No. 769. The Utilisation of Wood, by T. L. Wilkinson, M.Sc., B.Sc.F.

4/30. No. 778. The Utilisation of Wood in Southern Rhodesia—Conversion and Disposal of Timber, by T. L. Wilkinson, M.Sc., B.Sc.F., District Forest Officer.

8/30. No. 791. The Utilisation of Wood in Southern Rhodesia: Fencing, by T. L. Wilkinson, M.Sc., B.Sc.F., District Forest Officer.

2/31. No. 809. Establishing Pines: Preliminary Observations on the Effects of Soil Inoculation. Issued by the Division of Forestry.

4/31. No. 817. The Raising of Forest Seedlings and Transplants on the Farm, by E. J. Kelly Edwards, M.A., Dip.For. (Oxon.), Acting Chief Forest Officer.

7/32. No. 857. Charcoal Burning on the Farm, by R. J. Allen, Forester, Rhodes Matopo School of Agriculture and Experiment Station.

11/32. No 869. Wind-breaks and Shelter Belts, by A. A. Pardy, B.Sc., Forestry.

1/33. No. 874. Tree Planting, by the Division of Forestry.

4/33. No. 888. The Vegetable Ivory Palm (Hyphoene ventricosa), by G. M. McGregor, B.Sc., District Forest Officer, Matabeleland.

8/34. No. 927. Some Facts about Tung Oil, by R. H. Finlay, B.A., Dip. For. (Oxon.), District Forest Officer.

8/34. No. 928. Some Trees, Shrubs, Shrubby-Herbaceous Plants, Climbers and Water Plants suitable for the Colony, by J. W. Barnes, Manager, Government Forest Nursery, Salisbury.

12/35. No. 974. Summary of the Annual Report of the Division of Forestry for the year 1934, by E. J. Kelly-Edwards, M.A., Dip. For. (Oxon.), Chief Forest Officer.

Price List of Forest-tree Transplants, Ornamental Trees Shrubs, Hedge Plants, Creepers and Seeds obtainable at the Government Forest Nursery, Salisbury.

HORTICULTURE

4/27. No. 637. Harvesting, Packing and Marketing of Deciduous and Tropical Fruits, by G. W. Marshall, Horticulturist.

8/27. No. 650. Coffee Culture in Southern Rhodesia, by G. W. Marshall, Horticulturist.

2/29. No. 725. Investigations into "Collar-Rot" Disease of Citrus, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad)

3/31.	No. 814.	Avocado Growing in South Africa, by Redvers J. Blatt, B.Sc., Ph.D.
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6/31.	No. 824.	Vegetable Growing in Southern Rhodesia: Tomato Culture, by G. W. Marshall, Horticulturist.
9/31.	No. 829.	Asparagus Culture, by G. W. Marshall, Horticulturist.
11/31.	No. 834.	Celery Culture, by G. W. Marshall, Horticulturist.
1/32.	No. 843.	Vegetable Growing in Southern Rhodesia: Onion Culture, by G. W. Marshall, Horticulturist.
2/33.	No. 876.	Notes on African Aloes (Parts 1-6), by H. Basil Christian, "Ewanrigg," Arcturus.
10/33.	No. 905.	Notes on African Aloes (Parts 7-10), by H. Basil Christian, "Ewanrigg," Arcturus.
5/34.	No. 920.	Citrus Fruit Growing in Rhodesia, by G. W. Marshall, Horticulturist.
7/35.	No. 960.	The Rhodesian Home Orchard, by G. W. Marshall, Horticulturist.

ENTOMOLOGY AND PLANT PATHOLOGY.

2/13.	No. 139.	Termites, or "White Ants," by Rupert W. Jack, F.E.S.
6/15.	No. 214.	Some Household Insects, by R. Lowe Thompson, B.A.
10/15.	No. 219.	More Household Insects, by R. Lowe Thompson, B.A.
2/21.	No. 385.	The Common Fruit Beetle, by R. W. Jack, F.E.S.
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1/28.	No. 665.	Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.
2/28.	No. 671.	Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.
6/28.	No. 696.	Ticks Infesting Domestic Animals in Southern Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.
11/28.	No. 714.	Trap Cropping against Maize Pests, by Rupert W. Jack, F.E.S., Chief Entomologist.
12/28.	No. 718.	Preliminary Experiments on the Control of White Mould of Tobacco, by J. C. F. Hopkins, B.S. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
3/29.	No. 732.	Two Common Diseases of Potato Tubers in Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.
6/29	No. 742.	What is Diplodia in Maize? An Answer to a Popular Question To-day, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
8/29.	No. 747.	Mycological Notes: (1) Seed Treatment for Maize against Diplodia; (2) Seed Treatment for Tobacco against Bacterial Diseases. Issued by authority of the Minister of Agriculture and Lands.

8/29. No. 748. Frog Eye Disease of Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

9/29. No. 753. Leaf Spotting of Tobacco caused by Mosaic, by J. C. F. Hopkins, B.Sc (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

9/29. No. 754. "Pinking" of Maize: Report of a Preliminary Investigation, by T. K. Sansom, B.Sc., Plant Breeder.

6/30. No. 784. Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.

6/30. No. 788. A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.

A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist. Supplement No. 1.

7/30. No. 790. Notes on the Control of Some of the More Important Insect Pests of Citrus in Southern Rhodesia, by W. J. Hall, Ph.D., B.Sc., Entomologist to the British South Africa Company in Southern Rhodesia.

10/30. No. 796. The Army Worm (Laphygma exempta, Wlk.), by Rupert W. Jack, Chief Entomologist.

11/30. No. 798. The Preparation of Bordeaux Mixture and Seasonal Notes on Tobacco Diseases, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.

1/31. No. 804. Locusts in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.

8/31. No. 825. Some Common Diseases of Potatoes in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), Plant Pathologist.

3/32. No. 848. Mycological Notes: Seasonal Notes on Tobacco Diseases: 3, Frog Eye; 4, White Mould; by J. C. F. Hopkins, B.Sc. (Lond.).

4/32. No. 850. Pests of Stored Tobacco in Southern Rhodesia, by M. C. Mossop, M.Sc., Entomologist.

6/32. No. 856. A List of Plant Diseases occurring in Southern Rhodesia, Supplement 2, by J. C. F. Hopkins, B.Sc. (Lond.), Government Plant Pathologist.

9/32. No. 861. Further Notes on Leaf Curl of Tobacco in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), Plant Pathologist.

11/32. No. 868. Cultural Methods and Tobacco Whitefly in Southern Rhodesia, by M. C. Mossop, M.Sc., Entomologist.

5/33. No. 890. Locusts: Instructions for dealing with Flying Swarms, by the Division of Entomology.

5/33. No. 892. The Tsetse Fly Problem in Southern Rhodesia, by R. W. Jack, Chief Entomologist.

5/33. No. 893. Experiments with Tsetse Fly Traps against Glossina Morsitans in Southern Rhodesia, by R. W. Jack, Chief Entomologist.

6/33. No. 894. Mycological Notes. Seasonal Notes on Tobacco Diseases. 6. An Unusual Type of Frog Eye Spotting, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist.

6/33. No. 896. A List of Plant Diseases occuring in Southern Rhodesia. Supplement 3. (New Records for period June, 1932, to May, 1933.) Compiled by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist.

7/33. No. 897. The Report of the Chief Entomologist for the year ending 31st December, 1932, by Rupert W. Jack, F.E.S., Chief Entomologist.

8/33. No. 899. The Black Maize Beetle (Heteronchus Licus Klug), by C. B. Symes.
10/33. No. 904. Notes on the Biology and Control of the Red Locust in Southern Rhodesia, 1932-1933. Part I.: Control of Locusts, by R. W. Jack, Chief Entomologist. Part II.: Biological Notes on the Red Locust (Nomadacris septemfasciata, Serv.), by M. C. Mossop, A.F.C., M.Sc., Entomologist.
10/33. No. 906. The Locust Invasion of Southern Rhodesia, 1932-33, by R. W. Jack, Chief Entomologist.
2/34. No. 911. Screw Worm. A Pest of Ranch Cattle in Southern Rhodesia, by A. Cuthbertson, Entomologist. Foreword by R. W. Jack, Chief Entomologist.
3/34. No. 913. Locusts: Instructions for dealing with Flying Swarms, by The Division of Entomology.
4/34. No. 915. Tsetse Fly and Game, by R. W. Jack, Chief Entomologist.
4/34. No. 917. The Life History of the Screw-worm Fly, by Alexander Cuthbertson, Entomologist.
10/34. No. 934. Mycological Notes. Seasonal Notes on Tobacco Diseases. 7, Spraying in Seed-beds and Lands, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
12/34. No. 938. The Destruction and Control of Locust Hoppers, by R. W. Jack, Chief Entomologist.
1/35. No. 942. Mycological Notes. Seasonal Notes on Tobacco Diseases. 8, The Mosaic Mystery. 9, Danger Points in Field Spraying, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
4/35. No. 950. The Control of Tsetse Fly in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.
4/35. No. 951. Suspected "Streak" Disease of Maize. Notice to Growers, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
6/35. No. 957. Annual Report of the Branch of Plant Pathology for the year ending 31st December, 1934, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
8/35. No. 962. The Report of the Chief Entomologist for Year ending 31st December, 1934, by R. W. Jack, Chief Entomologist.
10/35. No. 969. The Objects and Value of Seed Treatment of Maize against Diplodia, by G. M. Wickens, Ph.D. (Lond.), D.I.C., Assistant Plant Pathologist.
5/36. No. 986. Annual Report of the Division of Entomology for year ending 31st December, 1135, by Rupert W. Jack, Chief Entomologist.
7/36. No. 993. Annual Report of the Senior Plant Pathologist for year ending 31st December, 1935. Part I.: Plant Pathology. Part II.: Tobacco Research, by J. C. S. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist and Officer in Charge of Tobacco Research Station, Trelawney.
12/36. No. 1011. Tick Infesting Domestic Animals in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist. Revised, November, 1936.

POULTRY.

1/29. No. 721. Poultry Keeping in Rhodesia: Pedigree Breeding, by H. G. Wheeldon, Assistant Poultry Expert.
4/29. No. 738. Hints to Breeders: Rearing Young Stock, by A. Little, Poultry Expert.

6/29.	No.	740.	Artificial Incubation, Breeding and Rearing of Chicks, by H. G. Wheeldon, Poultry Expert.
11/29.	No	761.	Housing and Feeding of Adult Stock, by H. G. Wheeldon, Poultry Expert.
10/30.	No.	795.	The Turkey, by G. H. Cooper, Assistant Poultry Officer.
1/31.	No.	803.	Geese, by G. H. Cooper, Assistant Poultry Officer.
9/31.	No.	827.	The Ideal Brooder, by F. Roberts, Assistant Poultry Officer.
10/32.	No.	865.	Poultry Industry: Care of Young Stock in Hot Weather, by H. G. Wheeldon, Chief Poultry Officer.
11/32.	No.	870.	Trap Nests, by B. G. Gundry, A.I.MechE. (combined with No. 875).
12/32.	No.	872.	The Poultry Industry: Rearing and Fattening of Table Poultry, by H. G. Wheeldon, Chief Poultry Officer.
1/33.	No.	875.	Another Trap Nest, by B. G. Gundry, A.I.Mech.E. (combined with No. 870).
3/33.	No.	884.	The Vitamins in Poultry Feeding, by G. H. Cooper, Poultry Officer, Matopo School of Agriculture and Experiment Station.
5/34.	No	918.	The Moulting of Poultry: The Normal and Pullet Moult, by H. G. Wheeldon, Poultry Officer.
10/34.	No	933.	Ducks on the Farm (Revised), by H. G. Wheeldon, Poultry Officer.
12/34.	No.	939.	The Use of Galvanised Iron in the Making of Some Appliances for Poultry Keeping, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.
12/34.	No.	940.	A Cheap Portable Colony House for Poultry, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.
3/34.	No.	947.	Modern Culling of Laying Hens, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.
9/35.	No.	966.	Egg Marketing Bill: Draft of a Bill having for its purpose the more orderly Marketing of Eggs.
11/35.	No.	971.	Feeds for Poultry and How to Use Them, by G. H. Cooper, Assistant Poultry Officer.

The following pamphlets can be obtained from the Poultry Officer upon application:—

Selecting Birds for Laying Tests, by A. Little, Poultry Expert.

Tuberculosis, by A. Little, Poultry Expert.

Prevention of Disease among Poultry, by A. Little, Poultry Expert.

Preparing Birds for Show, by A. Little, Poultry Expert.

The Fowl Tick (Argas persicus), by A. Little, Poultry Expert.

Culling: A Seasonal Operation, by A. Little, Poultry Expert.

Choosing a Male Bird, by A. Little, Poultry Expert.

The Breeding Stock, by A. Little, Poultry Expert.

Diseases of the Digestive System, by A. Little, Poultry Expert.

Mating for Improvement and Increased Egg Production, by A. Little, Poultry Expert.

Partial Moult: Broodiness. Selection of Layers of Large Eggs, by A. Little, Poultry Expert.

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Condition of Birds on Show, by A. Little, Poultry Expert.

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Good and Bad Hatching Eggs, by A. Little, Poultry Expert.

Grading Fowls, by A. Little, Poultry Expert.

Housing: Three Important Essentials, by A. Little, Poultry Expert.
Advice to Prospective Poultry Farmers, by A. Little, Poultry Expert
Seasonal Hints—August, by A. Little, Poultry Expert.
Successful Chick Rearing, by H. G. Wheeldon, Assistant Poultry Expert.
Hints to Breeders, October, by A. Little, Poultry Expert.
Abnormalities in Eggs, by A. Little, Poultry Expert.
Hints to Breeders. Prepare for the Breeding Season, by A. Little.
Respiratory Diseases, by A. Little, Poultry Expert.
Selection and Preparation of Fowls for Exhibition, by H. G. Wheeldon, Poultry Expert.
The Close of the Hatching Season and After, by H. G. Wheeldon, Poultry Expert.

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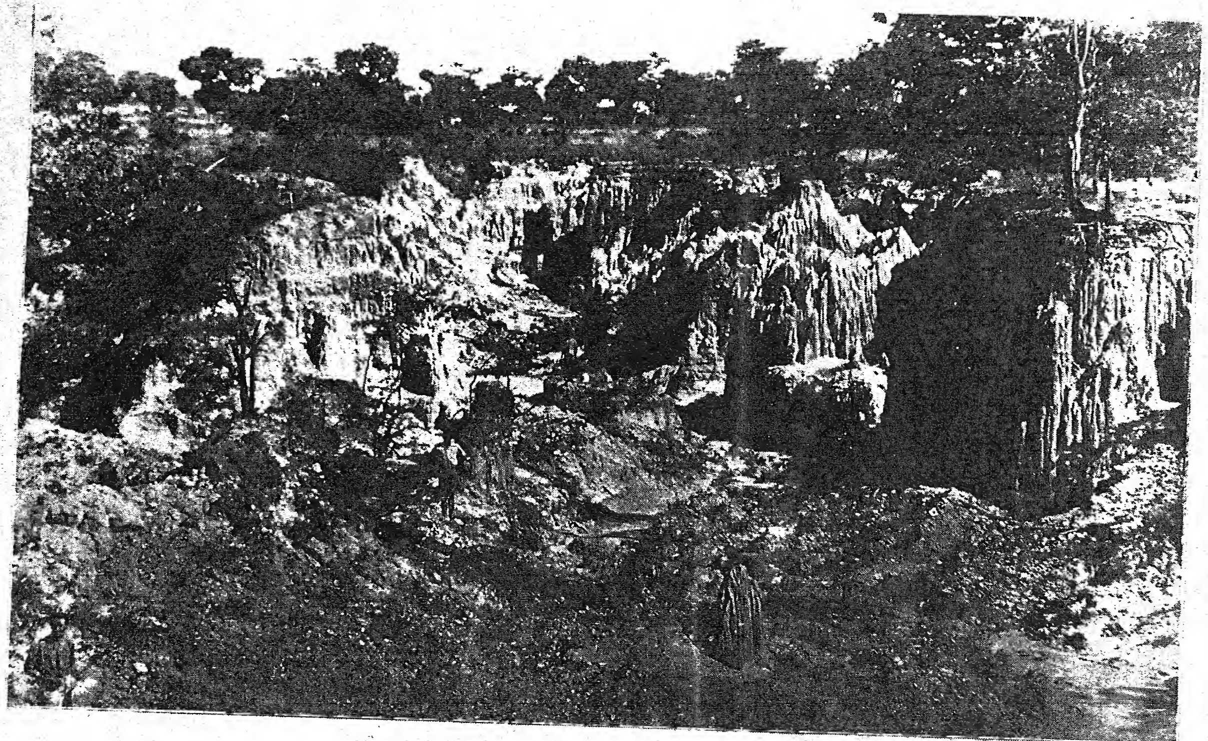

[Frontispiece.

A menacing gully.
Note the lateral and headward erosion.

THE RHODESIA

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Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Agricultural Lime at Reduced Cost.—At the Rhodesia Agricultural Union Congress held in Salisbury last year the following resolution was passed: "The Government be asked to investigate the possibilities of obtaining a reduction in the landed cost of agricultural lime."

The Department of Agriculture wishes to record its appreciation to both the General Manager of Railways and also to the suppliers of agricultural lime for favourably considering its request for reduced costs.

The railway rates on truck-load consignments has been reduced as from January 25th, 1937. The reduced rates apply

(*c*) One-fifth of the loan can be paid out as soon as the applicant is ready to start the works, and the balance is paid on the certificate of an engineer of the Irrigation Division that the works have been satisfactorily completed and are valued at the amount covered by the loan.

In addition to the above financial provision an arrangement has been made with the Premier Portland Cement Company (Rhodesia), Limited, whereby supplies of cement at reduced rates are available to farmers for use in water conservation works as under:—

1. Farmers who obtain a loan from Irrigation Loan Funds or from the Land Bank for the purpose of constructing water conservation works can obtain the cement required for the construction of these works on a Government requisition at a reduced price of 2s. 7d. nett per bag (94 lbs.) f.o.r. Cement Siding. The requisition for the supply of cement will be issued by the Irrigation Engineer responsible for the inspection and supervision of the works proposed.

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2. Farmers who do not desire a loan and are willing to pay cash for the cement required for the construction of water conservation works, may obtain the benefits of the reduced rates subject to the following conditions:—

(*a*) A cheque in favour of the Premier Portland Cement Company (Rhodesia), Limited, should be sent to the Director of Irrigation, Box 387, Salisbury, or to the Irrigation Engineer (Matabeleland), Box 566, Bulawayo. Such cheque to cover the cost of cement at ordinary rates, namely, 3s. 1d. per bag (94 lbs.) for lots of 50 bags or over, and 3s. 3d. per bag for smaller quantities limited to a minimum order of 24 bags, plus railage charges if the cement is to be consigned to a siding, and the railage charges have to be prepaid.

(*b*) After an inspection of the works by a Government Engineer and certification that the cement has been utilised in the construction of the works, the

difference between the price paid and the reduced price of 2s. 7d. per bag will be refunded to the farmer by the Cement Company.

Applications for these loans should be made to the Secretary, Department of Agriculture and Lands, P.O. Box 387, Salisbury.

Tung Oil: Information Required.—For a number of years past the Forestry Division has been supplying tung oil seeds to farmers in various parts of the country for experimental purposes. Although little was known of the possibilities of this crop under our conditions, a number of farmers have planted several thousand trees with the idea of establishing commercial plantings. A number of trees are now five years old or more, and the Department of Agriculture is anxious to obtain reports indicating how the trees have done in different parts of the country. Full particulars regarding the type of soil used, the rate of growth, with a photograph, if possible, would be particularly welcome.

It is obvious that there are still a number of questions upon which more information is required in connection with the growing of tung oil. This is indicated by an enquiry recently received from a farmer who has over 15,000 trees either in plantations or nursery beds. He is anxious to obtain the opinion of other growers on the following points:—

1. What is the best time of the year for planting out the seedlings?
2. Is it advisable to cut the young trees back? If so, at what age should it be done, and at what time of the year?
3. Is irrigation during the dry season likely to be beneficial to the crop?
4. Have any signs of disease been noticed, and if so, what are the symptoms?
5. What is considered the most suitable artificial fertiliser for use in (*a*) Nurseries, (*b*) Plantations?
6. Is anyone in a position to state whether *Aleurites montana* is better suited to our conditions than is *A. Fordii?*

Vegetable Oils and Oil Seeds.—The Imperial Economic Committee, in a statistical review of world production and trade entitled *Vegetable Oils and Oil Seeds* (price 2s. 6d.; 2s. 9d. post free), points out that the consumption of fatty oils of vegetable origin has developed enormously with the increased demand for fats, although animal products, that is butter, lard and tallow, remain the principal individual fats of commerce. The seeds and nuts of many different plants and trees can be made to yield oil; the review deals with those of chief commercial importance, and in view of the strength of its rivalry adds an appendix on whale oil.

The British Empire, particularly in India and the Colonies, is an important producer of vegetable oils and oil seeds, and many parts of the Empire carry on a considerable export trade. On balance, the Empire has a substantial net export for many of the oil seeds and nuts, notably ground nuts, palm kernels and copra. There is, however, a large net import into the Empire of cotton seed, linseed and soya beans.

Prices for vegetable oils and oil seeds fell severely during the depression. The lowest sterling prices were reached in 1934. Despite the improvement which took place in 1935 the average prices in that year for most kinds of oils and oil seeds ranged between 50 and 70 per cent. of the 1927-29 average. There was generally a further improvement in 1936.

Cotton seed is an important source of income to the cotton farmer. Almost the entire output in the United States, which is by far the largest producer, is consumed at home and exports from India, the second largest producer, have been negligible in recent years. Egypt, the Anglo-Egyptian Sudan and Uganda are the principal exporters of cotton seed, while there are only two large importers, the United Kingdom and Japan.

Argentina, the largest producer of linseed, accounts for over four-fifths of the world exports. India and Uruguay are next in importance. Imports into the United Kingdom come almost entirely from Argentina and India, and since 1933 the latter has been the chief supplier, except in 1935.

India and China are the principal producers of ground nuts, but both retain a large part of their production. Senegal, Nigeria and the Gambia, on the other hand, export the greater part of their output. France, the first European country to import ground nuts, still maintains its place as the leading importer.

The largest exporters of copra are the Netherlands East Indies and the Philippines, the latter also shipping large quantities of cocoanut oil. Exports from Empire countries amount to roughly one-third of the world total. British Malaya and Ceylon are the chief Empire exporters, but the trade is of greatest importance to Fiji, accounting for about 13 per cent. of the value of all domestic exports between 1931 and 1935. Imports into the United Kingdom, which have tended to increase, are now shipped entirely from the Empire.

Snails and Slugs on Strawberry Fruits.—Since it has been reported lately that slugs have been causing trouble in strawberry lands by eating into the fruits, all strawberry growers who experience trouble with this pest are informed that it can be controlled quickly and effectively by means of a poison bait. Crush two tablets of "Meta-Fuel" or "Meta-Heat" to a powder and mix the latter dry with one pound of wheaten bran, then moisten the mixture until it is like stiff mealie meal porridge. Spread this bait shortly before dusk thinly between alternate rows of strawberry plants. Five to six pounds of bait should be sufficient for one acre of strawberries. "Meta-Fuel" is a substance which is commonly used for heating water and other substances. The cost is usually 1s. 9d. to 2s. 6d. per packet of fifty tablets (7½ ounces). This bait, which is effective against snails and slugs wherever they are found, can be used by anyone who is troubled with the pest.—(G. C. Haines, Union of S.A. Press Service.)

SOIL CONSERVATION.

[This publication brings up to date and replaces the earlier Departmental Bulletin No. 923, "Soil Erosion," which is now out of print. It is issued by authority of the Central Soil Conservation Council, and prepared by D. Aylen, Esq. Outside Technical Assistant, and R. Hamilton Roberts, B.Sc., A.M.Inst.C.E., Irrigation Engineer, both members of the Propaganda Sub-Committee.]

Foreword by Capt. the Hon. F. E. Harris, Minister of Agriculture.

I wish to take this opportunity, on behalf of the Government of Southern Rhodesia, to thank and congratulate the Soil Conservation Councils, the Propaganda and Local Sub-Committees, and the Local Technical Assistants, on the good work they have done in connection with the Soil Conservation campaign, not only in getting the landowner and the general public to realise more fully the grave danger of soil erosion, but also—and this is very important—in making known by means of lectures and demonstrations practical and cheap methods of preventing erosion. The result of their labours is now beginning to be seen throughout the Colony, but we still have a very long way to go. I trust this Bulletin will be studied by all owners of land, and that it will be translated and explained to all natives in our Reserves.

The question of soil conservation is truly a national one, and must play a great part in the development of our Colony.

F. E. HARRIS,
Minister of Agriculture and Lands.

CHAPTER I.—GENERAL.

INTRODUCTION.

It has been said that "the skin of an animal is not more necessary to its well-being than is the vegetative cover of the earth essential to the proper condition of the soil." This

statement epitomises the problem of soil erosion, and points the moral that it is the hand of man that has turned formerly fertile and populous lands into deserts of desolation by the removal of that protection.

Historical Evidence.—History and archæology offer overwhelming evidence to support this view. There is ground for belief that all the great deserts and waste lands of the earth once supported enormous populations. The Sahara, the Central Asia deserts, arid parts of Palestine, Mesopotamia, the Gobi and North China deserts, all show remains of cities, temples, reservoirs, aqueducts and other evidence of vast cultures and civilisations, long since vanished and buried beneath the sands of the deserts that man's destructive handiwork had created out of the once fertile lands on which he depended for sustenance. These catastrophes have often been attributed to adverse climatic changes, but there is evidence to show that man-made erosion is sufficient to account for the wasting process without prior climatic change.

American Experience.—We have a modern example in North America. Three hundred years ago the colonists began the exploitation of a continent of enormous natural resources. In extending the bounds of civilisation they cleared the forests and exposed the soil to cultivation, on a scale which ran eventually to millions of acres. Their pioneer work was magnificent, but the results have been disastrous, because it was not realised that pioneer methods must be drastically altered once a country has become permanently settled. America has witnessed a process of erosion and dessication that has probably been more rapid than any hitherto known to history. In that brief period, through suicidal misuse of land, 51 million acres are estimated to have been utterly destroyed and abandoned (not including vast areas under semi-desert conditions), and 200 million more to be in the clutches of erosion. All good land in that vast continent has been taken up, and it is no longer possible to move on to new lands in the West. The time has come for the conservation of the remaining soil.

Position in Southern Rhodesia.—We in Rhodesia have a similar problem to face, smaller in scale and as yet not so far advanced, but equally rapid in its progress, if not checked

in time. The process has begun. Parts of Matabeleland were well grassed and watered by permanent streams forty years ago. To-day those areas are denuded, and the river-beds are filled with dry sand. (See fig. 1.) In Mashonaland the areas of rich virgin soil which have been opened up since the days of the early settlers have in many cases been "mined," and the soil impoverished by continuous cropping and erosion until many of those lands have been abandoned as useless. The best land is often the worst sufferer, owing to the owner's blind faith in its supposedly inexhaustible fertility, and conversely the best farmers are often found among those who have had to struggle with poor shallow soil and have realised its limitations and the danger of erosion. In other cases, farmers continue to flog the dead horse by trying to extract a living from an impoverished soil. Owing to the reduced yield, the acreage is extended in order to obtain a larger crop, and this process continues whether prices are high or low. When prices are low every effort is made to increase the volume of production in order to meet working costs. When prices are high the farmer is anxious to take advantage of the opportunity for a bigger return.

Conservation vs. Exploitation.—The policy of exploitation is a short-lived one, and can only have one end—abandonment of the land. Good land is not plentiful, and every acre sacrificed to a temporary cash return means a loss of capital, which the country cannot afford. Exploitation should be and is obsolete, and what is required is a new attitude of mind, an attitude which is convinced that exploitation is the more expensive process in the long run, and that it must be replaced by conservation.

Soil conservation is a wide term, and is not confined entirely to "contour ridging," but includes any and all measures aimed at protecting the soil. In its essentials it is a matter of wise use of land and good farming practice.

DEPARTMENTAL WORK AND POLICY.

It is many years since informal propaganda and warnings to farmers with regard to the dangers of erosion were initiated by officers of the Irrigation Division, and in October, 1921, there appeared the first article on "Soil Washing" in the

Rhodesia Agricultural Journal. This article was followed by numerous others from time to time, each more detailed as experience was gained and the subject was taken more seriously by the farming community. The early propaganda was chiefly concerned with the erosion of cultivated lands, and it was this branch of the work which made the greatest advance.

Progress of the Work.—In the early years of the movement progress was necessarily slow, and a tribute is due to those few stalwarts who acted as pioneers and whose foresight and energy set an example for others to follow. Up to 1929 the construction of storm-drains and contour ridges was confined to a few dozen farms at most, and that year was the first to record an appreciable amount of protection work being carried out. After 1929 the rate of progress improved, but it became evident that further propaganda was required to bring home the benefits of protection more generally to farmers. The necessary impetus was supplied by the special Sub-Committee of the Rhodesia Agricultural Union, appointed in 1932, whose report led to more widespread publicity, the establishment of Central Soil Conservation Councils and local Sub-Committees in the country districts, and the appointment of outside technical assistants to enable more farms to be visited. These measures are dealt with more fully later. The results of this policy are briefly indicated in the following table:—

Year.	Miles of Ridge Terracing.	Approximate Acreage of Land Protected.
1929	76	2,280
1930	103	3,090
1931	150	4,500
1932	108	3,240
1933	132	3,960
1934	126	3,780
1935	367	11,040
1936	535	13,375*
Totals	1,597 miles	45,265 acres

(*Based on 25 acres per mile of ridge instead of 30 acres per mile, as in previous years.)

A Comparison.—These figures clearly reflect the accelerated rate of progress during the past two years due to the wider publicity and greater assistance available to farmers, and should give general cause for satisfaction. This satisfaction, however, is tempered by a comparison of the protected area with the total area under summer crops, which in the 1935/36 season was 428,939 acres. Even if the protected area is increased by an allowance for works privately done, and of which no records are available, the proportion protected to date can hardly exceed 11 per cent. of the total, and in addition there is the area of winter-cropped land to be considered. At the present rate of progress some 3 per cent. of the arable land of the Colony is being brought under protection annually, and a little reflection will show that a still more rapidly accelerated rate of progress must be achieved if a large proportion of the land is not to be irretrievably ruined. Much can be done by propaganda and the various forms of Governmental assistance to provide the necessary acceleration, but the remedy ultimately rests in the hands of each individual farmer, who has little excuse to-day for not realising the necessity of protecting his land and conserving his assets.

Free Technical Assistance has long been provided by the Government, and it is many years since the small charge for such assistance was dropped, except in the cases of special or protracted visits. The services of the Engineers of the Irrigation Division are available free of charge to any farmer during the course of the (frequent) tours of his district, and in the last two years these services have been supplemented by the appointment of two "outside technical assistants," who have done noteworthy work in their districts. So successful has the system been that it is hoped during the current year (1937) to appoint four more such assistants in various outlying districts. This is being done in anticipation of a more general demand, due to another form of Governmental assistance, the Demonstrations, which are held in various local centres and have provided a much-needed practical exposition of the methods

of construction and the working of the land. A tour of demonstrations was conducted in 1936, and a further, more extensive, tour is proposed for 1937.

Financial Assistance.—Irrigation (Imperial) loans were first introduced after the grant of Responsible Government, but were not extensively applied for, and were dropped for a time. The new system of loans was made available in 1929, and financial assistance is now being increasingly given, at low rates of interest and on easy conditions of repayment, for such purposes as soil conservation, dam and weir construction, and the sinking of boreholes. Other loans are obtainable for the erection of fencing and dip tanks. Apart from loans, the cause of water conservation has been assisted by arrangements to supply cement at cheap rates, and the payment of rebates of up to 25 per cent. of the cost of dams and storage weirs. Financial assistance is also available to local sub-committees for the purchase of ditching implements, etc.

Experimental Work.—Space does not permit of more than a brief mention of the two experimental stations, one in Mashonaland and another in Matabeleland, that have been established to investigate the nature and amount of water and soil losses from protected land, and which have already given valuable results. Experimental work is also to be carried out on the treatment of gully erosion, and it is to be hoped that this may be extended to other phases of research work.

Organisation.—As a result of the R.A.U. sub-committee's report in 1932, previously mentioned, Central Soil Conservation Councils, with a representative membership, have been established in Salisbury and Bulawayo, and through their efforts a system of local district sub-committees has come into existence. These sub-committees have already proved exceedingly valuable in carrying out their duties of creating and maintaining a practical interest in soil conservation, arranging demonstrations, and dealing with all local phases of soil erosion problems and their treatment. It is through this policy of de-centralisation and the creation of local bodies that it is hoped to disseminate as widely as possible the principles and practice of soil conservation, and the results to date encourage every hope of substantial achievement in the future.

General Process of Erosion.—Rainfall is disposed of in four ways :—

1. Run-off.
2. Evaporation.
3. Absorption.
4. Transpiration by plants.

The first two are essentially wasteful, and only the last two are beneficial.

Upsetting the Balance of Nature.—Under its natural covering of vegetation, the earth's surface maintains a natural balance between the processes mentioned above, the rainfall is checked when it reaches the earth, and a maximum amount is absorbed and made available for plant growth and for the replenishment of the underground reservoirs which feed the springs that maintain stream flow. When the vegetative cover is removed by any agency (such as over-stocking or the cultivation of the land) the amount of rainfall lost by direct run-off and evaporation is increased at the expense of absorption. An accelerated process of erosion begins at once. The exposed surface of the earth, unable to restrain the amount and velocity of the run-off water, is torn away by the rush of water, the lightest and most fertile top-soil being the first to go, and before long the intractable and unproductive sub-soil is exposed. Floods increase in violence, and the rivers are swollen beyond their bounds and in many cases cause untold damage. The clear waters of the rivers are turned into torrents of liquid mud, and dams and weirs are silted up at a disastrous rate, reducing the useful life of the reservoirs and leading to unnecessary expenditure on replacing or enlarging water storage schemes. Grazing deteriorates, due to the lack of fertile top-soil, and the deterioration of grass cover leads to accelerated erosion, so that grazing areas become progressively less able to support animal life.

Evaporation.—The losses of water through run-off, particularly flood run-off, are so strikingly obvious that it comes as a surprise to most people to learn that evaporation losses are actually very much greater, although invisible and difficult to measure. The Union Drought Commission found that only 6½ per cent. of the total South African rainfall

reached the sea, and that of the remaining 93½ per cent. a large proportion, possibly the majority, must be lost in evaporation.

Evaporation from an open sheet of water is sufficiently serious under arid conditions (up to 100 inches per annum), but it takes place even faster from damp soil, owing to capillary action which draws water to the surface, and within reach of the sun and wind, even after it has sunk into the soil. Evaporation is aggravated by the same process which increases run-off, namely, the destruction of the vegetal cover and the erosion of the absorptive surface soil. Evaporation depends principally on two factors: temperature and wind. When the natural protection of the earth is removed, the soil is exposed to the fierce heat of the sun and the drying action of the wind. Moreover, the destruction of grass and bushes eliminates the channels by which the water was able to penetrate the sub-soil. Furthermore, the top-soil is the more porous, owing to the humus it contains, but when swept away by erosion the sub-soil, which is often relatively impervious, is exposed and the water, unable to penetrate deeply, is lost by run-off and evaporation.

This brief explanation shows why the destructive processes described under the heading "Veld Erosion" have such a disastrous effect on the water resources of the country. The same ill-effects take place on cultivated lands, if they are not properly protected.

Effect on Cultivated Lands.—Lands cleared for cultivation are the natural prey of erosion. The unprotected surface soil is rapidly carried away by "sheet" or gully erosion, or both. What is left is coarse material or poor sub-soil, the lighter and more productive elements, such as the humus and the soluble salts, being the first to go. Crop yields deteriorate, and crops are more liable to disease and parasites, such as witchweed, that are washed into the land from the veld. The soil's power of absorbing water is decreased, which in itself accelerates the rate of run-off and erosion, and the crop is liable to suffer quickly from drought in dry spells of weather. Gullies grow, and cut into the land, draining away the moisture and the soil, and making it impossible to work the

land as a whole. Every farmer will admit the difficulty of growing good crops, except under favourable conditions; with an unchecked process of erosion, every hand of Nature is turned against him.

Effect on Water Supplies.—The reduction of the amount of water absorbed into underground supplies leads to a falling-off of the flow of springs and streams and the disappearance of wet vleis, which dry up more quickly. Underground supplies to wells and boreholes are diminished, and it is found that the "water table" has fallen seriously. To this extent there is foundation for the oft-heard statement that "the country is drying up." It is not that the climate has changed, but that the *effective* amount of rainfall tends to become less and less.

The Drought Commission.—In this connection it is instructive to quote the Drought Investigation Commission, appointed in the Union of South Africa in 1920. Their Report states:—

"As a result of the conditions created by the white civilisation in South Africa, the power of the surface of the land to hold up and absorb water has been diminished, and the canals by which the water reaches the sea have been multiplied and enlarged, with the result that the rain falling has a lower economic value. The diminished capacity of the country to hold up and utilise the rain which falls has been caused by the deterioration of its protecting vegetal cover and by soil erosion."

Water and Soil Conservation Related.—A whole volume could be written on this subject alone. The preceding paragraphs must serve as an introduction and should have indicated that soil erosion and wastage of water are essentially complementary, and are both caused by the removal of the earth's natural vegetal cover. This fact cannot be too deeply impressed.

Several lessons are to be learnt from this bald statement of fact:—

(*a*) that soil conservation works and methods will have a beneficial effect on water supplies, and conversely,

the building of dams and weirs, particularly small ones on the head-waters, will act as a check to soil erosion;

(*b*) that where nothing is done to prevent soil erosion, the construction of water storage schemes will be a sheer necessity, and these schemes will be expensive and short-lived owing to the violence of floods and the deposition of silt.

The two subjects are seen to march side by side, and in practice their relationship is illustrated in a great variety of ways.

Examples.—As an example of (*a*) above, a case may be quoted of a farm, originally waterless, where the "contour-ridging" of the arable land and the prevention of burning on the adjoining veld has resulted, in four years, in a permanent flow of water in the hitherto dry stream below the land. On the other side of the picture is the position which sometimes arises from the necessity of constructing a large system of storm-drains round cultivated lands in hilly country. For the sake of economy, these drains are often made of small dimensions and steep gradient, with the result that large volumes of storm-water, no longer able to soak away into the long grass which originally covered the now cultivated area, are discharged in miniature floods. It must not be forgotten that the volume of storm-water has all too often been increased by burning and over-grazing the hillsides. A prevention of these evils will improve the position, but something more is required; the provision of small dams in the vleis and stream channels in order to retain the water on the farm and put it to beneficial use. This is a subject which is beginning to have greater attention paid to it, and as time goes on it will become of more and more importance.

Small Dams.—Passing to the second part of (*a*) above, it is not yet sufficiently realised what benefits can be secured from the construction of small dams in minor valleys and vleis, or at what small cost. With a dam scraper and a few oxen at odd times when they can be spared, the actual cost is very small, and the benefits out of all proportion. Soil erosion is decreased, grazing is improved, temporary water

supplies are obtained, the general water level is raised, the intensity of floods is reduced, with a corresponding check on the growth of gullies, and an otherwise inferior stretch of grazing land turned into a permanent asset.

In the same way, small dams of earth or stone built across small gullies in arid areas, even though they may not hold water for more than a few days or weeks, will impound a portion of every storm and so add greatly to the underground storage in the immediate locality. A well sunk on the bank of the gully near such a dam or system of dams might otherwise be dry, but will usually be found to give a good supply, as it will have an underground reserve to draw upon.

One might multiply examples, but the moral is clear.

Storage Schemes.—With regard to the construction of large storage schemes, it is sufficient for the purposes of this article that their construction is essential to the development of arid or semi-arid areas, particularly when the country becomes desiccated and surface water disappears. The Union of South Africa has spent vast sums on such schemes, and this Colony is forced to follow a similar policy in the more arid areas, though on a much smaller scale. The point with which we are at present concerned is how far the construction of storage works is affected by soil conservation or the lack of it. In the first place, the actual necessity for many of these dams, particularly of that large class of dams of moderate size intended for watering stock, is caused by the very denudation of the country, such as the filling of the rivers with sand and the disappearance of surface water supplies. In this way large sums of money are forced to be spent in order to remedy the destruction of natural resources. Secondly, there is the increased cost of these structures, due to the evils of silting and the violence of floods resulting in the necessity of building dams of excess storage capacity and greater strength, and of replacing them by further dams as they silt up. Expenditure on these lines has reached vast proportions in America.

The short cut to avoiding such unnecessary expenditure of public and private funds is to alleviate the trouble at its source and prevent and repair the ravages of erosion in its early stages.

CHAPTER II.—VELD AND GULLY EROSION.

Veld Erosion.—The general causes of veld erosion have already been indicated. The specific causes with which we are mainly concerned in this country are:—

1. Over-stocking.
2. Wood cutting and burning.
3. Cattle tracks.
4. Roads.

These factors, of course, are often inter-connected. Thus overstocking leads to formation of cattle tracks, cattle tracks often become roads, and wood cutting leads to an excessive number of tracks and roads.

Over-stocking.—It is necessary to realise that the "carrying capacity" of a grazing area varies enormously according to the climate, character of soil and type of grass. What is moderate in a humid well-grassed country will be excessive in an arid land. Over-stocking is therefore at its worst, from the erosion point of view, in an arid or semi-arid area. It is hardly necessary to elaborate the destructive effects of stocking at a rate of five acres to a beast on country which is barely capable of supporting a beast on 20 or 30 acres. In a few years the grass is totally trampled out, the soil is swept into the gullies and "rivers," which are filled with sand, water supplies both surface and underground disappear, cattle deteriorate in physique until all virtue except precarious survival is gone from them, and in time of drought, which is naturally more severe and prolonged under such conditions, they die by thousands. In the 1936 drought, losses of 50 and 60 per cent. of the herds were common in parts of Matabeleland, both in native and European areas. Such a state of affairs causes terrific loss to the country, in two ways: (*a*) the actual loss of the stock, to say nothing of the impoverished condition of thousands of others that survive, and (*b*) more serious still, the eventual loss beyond recovery of vast areas of country that will infallibly revert to desert.

Remedial Measures.—There are only two remedial measures, and both are dependent on adequate fencing:—

(*a*) reduction or re-distribution of stock to a degree comparable with the "carrying capacity" of the land, combined with a rotation of grazing controlled by fencing into paddocks, and

(*b*) provision of a sufficient number of dip tanks and water supplies to prevent excessive trekking and concentration of stock.

The effect of giving a grazing area a rest can be little short of miraculous. An example occurred during the outbreak of foot and mouth disease, when a five-mile strip adjoining the Bechuanaland border was kept clear of stock for a couple of years. At the end of that time the country, which had been as bad as any, had recovered to a remarkable extent.

The value of a rotation of grazing lies in the fact that it is the *trampling* of animals in search of food and water, and not the actual grazing down, that causes erosion. In other words, the hoof is worse than the mouth.

Over-stocking is probably the largest single erosion problem that faces the country. It is a more difficult problem than that of erosion on cultivated land, for the reason that it applies to a vastly greater extent of the land surface, and is complicated by all manner of factors such as the native ownership of stock (cattle *and* goats, the latter being the more destructive), the adverse climatic conditions in those areas where the problem is most serious, and above all the expense of applying the remedial measures on a large scale in the present state of the cattle market.

Nevertheless, the problem must be solved, or the "cattle country" of Rhodesia can have little hope of escaping an eventual, and not distant, fate of abandonment.

Government assistance is already available in connection with fencing, dip tanks and water supplies. Special Irrigation Loans on easy terms are available for the sinking of boreholes and the construction of dams and weirs. Fencing and dip tanks are among the permanent improvements covered by the

short-term loans obtainable from the Land Bank, and it is hoped that more extensive assistance in the matter of fencing may be provided.

Paddocking.—The ideal to be aimed at is a ranch or farm divided up into paddocks of a size suitable to the type of country, each paddock having direct access to water (such as a borehole sunk at the junction of four paddocks). It is to be noted that the provision of a few large water supplies, without paddocking, is not likely to improve the position, nor, conversely, will a system of paddocking be effective without an adequate provision of water supplies. No rule can be laid down as to the number of dip tanks, but it should be according to the distances involved and the total number of cattle. The number and size of paddocks will depend largely on topographical conditions and the possibility of providing water supplies where required, but they should be planned with a view to regular rotation of grazing, bearing in mind the diminished feeding value in the dry season. In this connection a great deal more might be done in the matter of growing summer crops to provide feed during the dry season.

The relation between water and soil conservation has been dealt with already, but it should be noted here that for *permanent* results a system of dams is better than boreholes, since without the conservation of surface water the underground supplies will be weakened.

Wood Cutting and Veld Burning.—Much damage has been done in the past, and is still being done, by these abuses. One has only to mention mining and tobacco farming to call to mind the many denuded areas in this country. The evil of wood cutting lies not so much in the destruction of the actual timber, as in the countless wagon roads that are made for the transport of the wood and are, in so many cases, left to wash out and become courses for torrents of destructive storm-water. It is to be hoped that the position will be improved by the more general modern use of crude oil engines and the activities of the Electricity Supply Commission, in the case of mines, and by the adoption of the more efficient furnaces now available, by the tobacco farmers.

The work of re-afforestation deserves every encouragement, and it is to be hoped that farmers in suitable areas will push on with a regular programme of tree-planting. Judicious felling of trees on hillsides is often found to improve the grazing and provide a better cover of grass, and this is true, provided that over-grazing and burning are avoided. It should be made a rule to prevent grazing on recently felled land, until the grass has become well established.

Veld burning is still all too common a practice in this country. There may be some excuse and foundation for burning in very humid areas, but there is no question that under any other conditions regular burning is a powerful cause of soil erosion. The fallen vegetable matter which should be allowed to decay and replenish the humus in the soil, is destroyed, and the surface of the soil, instead of being in an absorptive condition when the rains come, is baked hard and dry.

The usual excuse for burning is that the new spring grass is made more easily available to stock, but it is not sufficiently realised that better results, from both the grazing and erosion points of view, can be obtained by properly controlled rotation of grazing and by cutting the long grass for hay. It is pleasing to note that the latter practice is becoming more and more usual with progressive farmers than it was in the past. Advocates of spring burning should realise that a diet of pure young grass, unaccompanied by coarse roughage, causes scouring in cattle and is therefore very lowering. For this reason, working oxen are often at their poorest a month after the rains begin. Another excuse often given for burning is the destruction of ticks. This is a fallacy, since ticks are dormant during the dry season, at the time that the veld is commonly burnt.

Uncontrolled Burning.—The most dangerous and harmful type of burning is the uncontrolled veld fire which sweeps across miles of country every dry season. In some cases they are due to lack of supervision or experience in burning grazing areas or fireguards, but in others the origin is malicious or wilful and the culprits more difficult to trace, and farmers should in their own interests make every effort to prevent uncontrolled burning, and report offenders to the police at

Fig. 1. A river of sand.

Fig. 2. Erosion caused by cattle-tracks near a dip-tank.

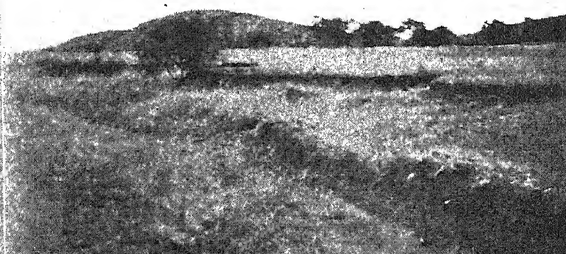

Fig. 3. Lateral erosion creeping out from an abandoned road.

the first opportunity. Under the new provisions Herbage Preservation Act, a farmer wishing to mak guards is entitled to call on his neighbour to do likewis farmers are urged to make use of this measure to preve spread of uncontrolled fires.

Cattle Tracks.—These are due to the concentrat stock, and are commonest near kraals, gates, watering and dip tanks (see fig. 2). Much can be done to redu danger of erosion if these places can be arranged to be si on level, and preferably stony, ground, and in the san the routes along which cattle are driven out to graze be as much as possible along the contour. That anim wiser than men is shown by the fact that on steep hills will invariably walk on the contour. Concentration ca be reduced by providing a larger number of water su and, if necessary, dip tanks. The formation of gulli be reduced by preventing cattle being driven up the of hillside valleys and insisting of them being kept on ground.

Roads.—The roads, and particularly the old ones, country have much to answer for in the way of erosion. among the offenders must be placed the wood cutting which so often run up to the hills and follow the l natural hollows. They therefore concentrate the flow of water and soon wash out into ugly dongas, which in parts of the country are a source of great trouble and da Miners and farmers should co-operate to block a r frequent intervals once it has been abandoned.

Road authorities to-day are alive to their responsil and dues in the matter of drainage, and the position is covered by the relative provisions of the Roads and Act, from the points of view of the road authority a landowner. The principle involved is that each pa responsible for leading his stormwater to the nearest r channel (within the same watershed) without tresp damage to the other party's property, and if this princ liberally interpreted by both landowners and road auth many potential disputes will be avoided. What is nee a generous attitude of give-and-take on both sides.

The subject is referred to later under the heading of "Legal Considerations."

Gully Erosion and Control.—*Gullies are formed by the concentrated flow of water at a velocity sufficient to overcome the resistance of the vegetation and the cohesion of the soil.*

Causes of Gullies.—They have their root cause in the interference with Nature through the removal of the vegetal cover. In the case of veld erosion, they may be due to any or all of the agencies discussed in the preceding paragraphs. On cultivated lands they may be due to the ploughing of a natural channel, to farm roads, to ploughing down the slope, cultivating slopes that are too steep, broken contour ridges, the ubiquitous "closing furrow" down a slope, boundary drains or other artificial channels on too steep a slope, or a dozen other causes.

Whatever their origin, they constitute a rapidly-growing and extending menace, and the longer their treatment is postponed the more expensive and difficult they are to control. The problem is complicated by the fact that a gully is often the only outlet for the storm water, and must perforce be used for that purpose.

Treatment.—A study of the definition printed in italics above will indicate the means of control to be adopted. Gullies are formed by water moving at too high a velocity. High velocities are partly due to excessive volumes of water, since on a given slope a large volume will travel with greater velocity than a smaller volume. Hence gully erosion may be reduced by any means tending to prevent excessive run-off from the catchment above the gully. These means include such measures as contour ridging on cultivated land, and improving the vegetal cover, *i.e.*, prevention of veld fires and over-stocking, etc.

Secondly, the gully, if not too large, can be made to resist erosion if the bed and sides are covered with resistant vegetation. This can be done by sloping the banks of a gully and planting, or encouraging the growth of suitable grasses or shrubs. These will not only resist erosion, but reduce velocity.

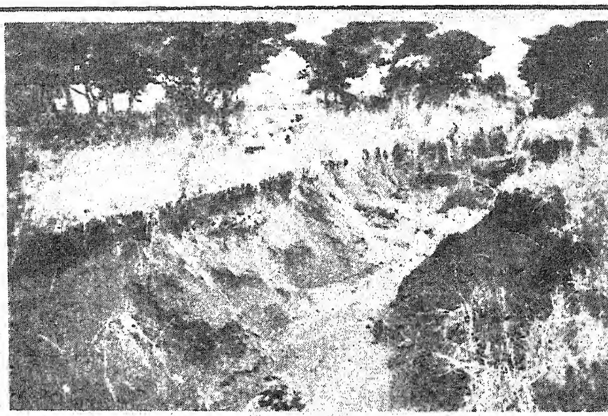

Fig. 4. A gully endangering a road.

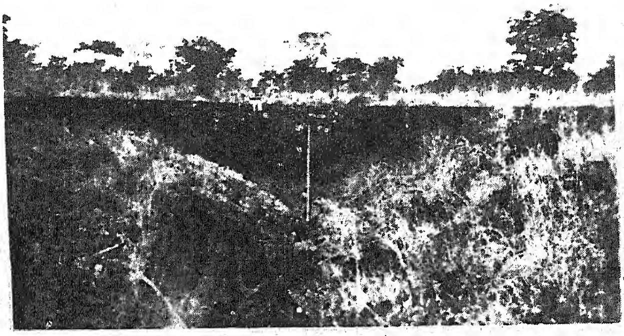

Fig. 5. Head of a gully. (Note the 16-foot staff.)

Fig. 6. Grass will grow on a sloping bank; a steep bank is unstable.

Thirdly, and most important, the velocity of flow is caused by the steep gradient of the gully bed. This must be flattened by the construction of check dams. Of these, more anon.

The treatment of any particular gully will depend on local conditions. As a general measure, the reduction of run-off water feeding a gully should be aimed at, by the construction of contour ridges or the improvement of the natural vegetation.

The worst type of gully is usually characterised by its sheer or overhanging banks, due to the cracking and breaking away of the clayey sub-soil. This type of gully grows laterally by the falling-in of the banks through undermining and the formation of tributary gullies, and it grows up the slope for the same reason by the cutting-back of its head, which may be very rapid. (See figs. 4 and 5 and frontispiece.) When the gully is very big, its control is difficult and expensive, which is all the more reason for tackling gullies at the outset.

Control by Vegetation.—When a gully is small and the gradient not too steep, vegetative control may be sufficient, and the same treatment may be combined with other measures in bigger and steeper gullies. Two conditions are necessary for the success of this treatment: (1) suitable soil and climatic conditions, and (2) the sloping of the banks. The reason for this is that grass will not grow on sheer banks, as is well illustrated in the photograph (fig. 6). The banks should be cut back to a slope which should not usually be steeper than 1 vertical to $1\frac{1}{2}$ horizontal, so that for a gully 6 feet deep the horizontal distance from top to toe of the bank should be 9 feet. In some cases the natural grass will take possession of this slope, but in others it will be necessary to plant the slopes. Among resistant grasses may be mentioned the various types of couch grass, paspalum, Napier fodder, Kudzu vines, and in general any local type of close-growing grass that does well, and in some cases poplar or willow may be effective. In any case the gully should be regularly inspected until it is evident that permanent results have been obtained. In small shallow gullies, strips of Napier fodder, etc., may be planted in rows across the gully at intervals, and are very effective in holding up coarse silt.

Check-dams.—The "stepping" of the bed of a gully is carried out by means of what are known as "check dams." These may be of all sizes and types, ranging from small temporary constructions of stakes and brushwood to large permanent earth dams and concrete weirs. In this country, owing to the ravages of white ants, wooden structures are too short-lived to make them usually worth the labour of making them, and more permanent materials are to be preferred. Checks of stakes, brushwood and grass are often effective in the sand veld, in areas free from white ants, and are also useful as temporary measures pending the building of more permanent checks, or while vegetative control is being established.

The following points should be carefully observed in installing check dams:—

1. The height should not be so great as to cause the gully to overflow and create new channels.

2. The ends of the dam must be carried well into and up the gully banks, to prevent outflanking.

3. The foundation of the dam must be deep enough to prevent undermining.

4. The centre of the dam must be low, and the ends high, so as to concentrate flow in the middle of the stream.

5. In nearly all cases it is necessary to provide an "apron" to prevent the formation of a pothole below the drop caused by the dam.

In addition to these points it should be remembered that a high-check-dam is more likely to fail or cause trouble than a low one, and it will usually be better policy to build a series of low check-dams and add to them in successive years as the gully silts up.

Materials.—Check dams should be cheap as well as lasting, and the materials should be chosen from those easily or cheaply available on the particular farm concerned. Fencing standards, steel sleepers, rails, pipes, fencing wire, pig netting, durable wooden posts such as mawanga, mopani or gum poles soaked in dip, stones, brick, gravel, earth, lime and cement are among those suitable for various types of check dam.

With the existing variety of materials and conditions a great many types of structure can be devised, and a few only are described below and illustrated in the accompanying drawings (figs. 7, 8 and 9).

"*Bolster*" *Dam.*—A useful type of check dam is that known as the stone-and-wire-netting bolster, which may be single or in two layers (*i.e.*, two bolsters at the bottom, and a third on top). The diameter is usually about two feet, so that checks to a height of two to four feet can be built in this way. "Pig netting," 13 gauge, 3-inch mesh, 6 feet wide, should be used. For each bolster a length of netting should be cut, long enough for the width of the bed and to reach well up each side of the gully. A trench 2 feet wide (for a single bolster) should be cut across the gully, fairly shallow in the bed and deeper into the two banks, and the length of netting laid in the bottom and up both sides of the trench. Stones of all sizes (not less than 3-inch) are then packed into the form of a sausage, until a diameter of about 2 feet has been obtained, when the sides of the netting are drawn together over the top of the stonework and tightly laced together with galvanised wire. An "apron" below the drop can be similarly constructed in the form of a flattened bolster, 2 or 3 feet wide and 6 to 9 inches thick, or the stones may be laid without the netting and the joints "grouted" with cement mortar. The apron should be laid in a shallow depression, excavated below the bed of the gully. If the bolster is found to allow the passage of silt and debris, it can be backed by a bank of well-rammed earth upstream to make it water-tight. Later, when the checks have silted up, a second bolster may be laid on the silt bed immediately upstream of the original bolster, but must be equally well anchored into the banks. The arrangement is illustrated in fig. 7.

"*Fence*" *Dam.*—Another type of check dam consists essentially of a low fence across a gully. The fence may be straight, but is preferably made in the shape of a bow or bay curved *downstream*. The uprights should be set 3 to 4 feet apart, and should project not more than 3 feet above the bed of the gully. The uprights may consist of fencing standards, durable wooden posts, steel rails, sleepers or pipes, and should be set not less than 2 feet deep. The banks of the gully should

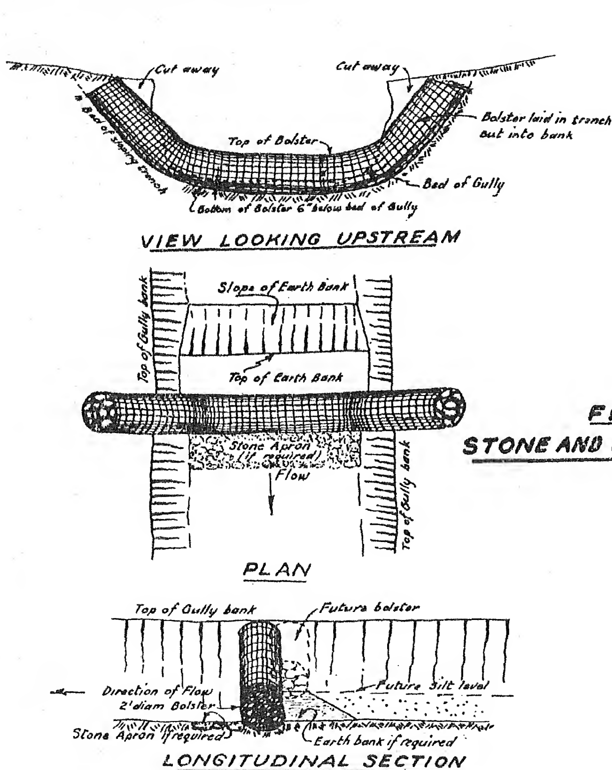

FIG. 7

STONE AND WIRE BOLSTER

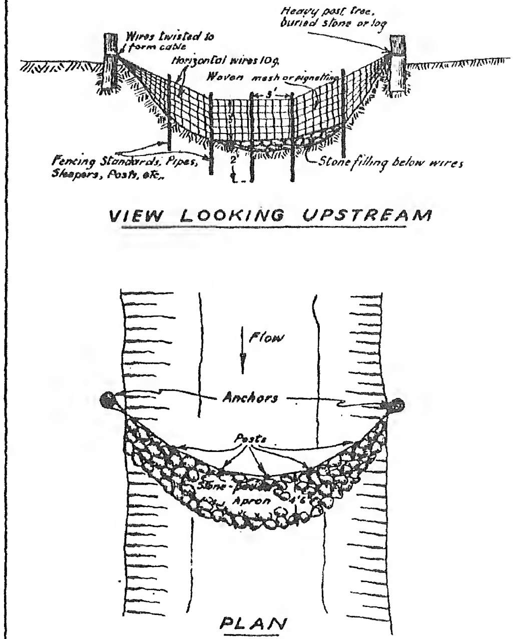

FIG. 8

"FENCE" TYPE CHECK DAM

Maximum Height:-3 to 4 feet

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be sloped off, if steep, and the posts set in the banks should be equally well anchored, and although they may be shorter, their tops must be above those of the central posts. The wiring of the "fence" should be not thinner than 10 gauge galvanised, securely fixed to the uprights, and at the ends of the fence the wires should be twisted together to form a cable, which should be secured to strong posts or anchors at the tops of the banks. Pig netting may be wired to the fence to make it more retentive of debris, or upright wires may be woven to the fence wires to form a mesh about 6 inches square. This type of check dam will almost always require a stone apron, owing to the sheer drop. The arrangement is illustrated in fig. 8.

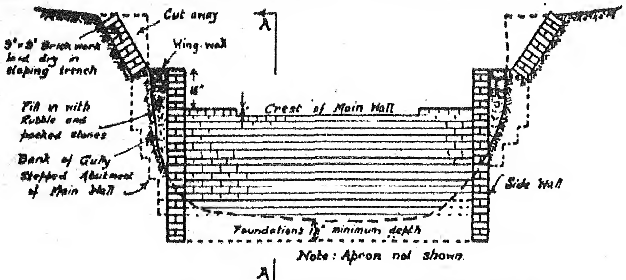
Brick or Masonry Dam.—A stronger and more permanent type of structure can be built in concrete, stone masonry or brick. The check dam consists essentially of a wall across the gully, and it is important to provide proper protection for the banks and for the drop below the dam. The height of the wall may be up to 4 or 5 feet, although it is usually better to start with a lower wall, and the dimensions will depend on the size of the gully and amount of stormwater. A thinner wall may be built if a good bank of rammed earth is placed against the upstream face. If this is done, the following dimensions may be used:—

In stone masonry, laid in 1:6 cement or lime mortar, a crest thickness of 6 to 12 inches, increasing to a thickness at the base equal to the crest thickness plus half the height of the dam.

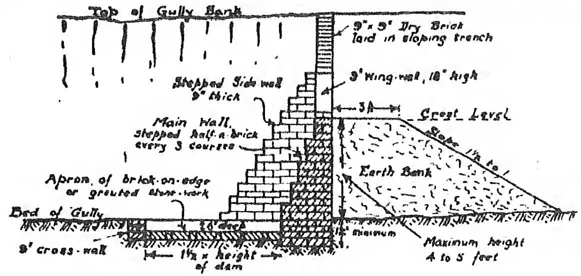
In brickwork, a crest thickness of 9 inches, increased to 14 inches three courses lower, 18 inches a further three courses lower, and so on. (See fig. 9.)

The foundation of the wall should be about 12 inches below the bed of the gully. The wall should be extended well into both banks, and at the same time brought up with a slope or step to the top of the bank, this portion being laid in a sloping or stepped trench cut to the top of the bank.

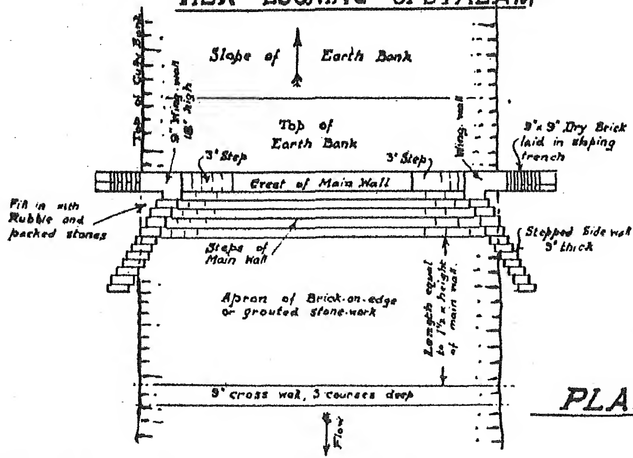
The type of apron will depend on the amount of stormwater and the height of the dam. For ordinary conditions a paving of stone may be laid in a depression excavated 6 inches



VIEW LOOKING UPSTREAM



SECTION AA



PLAN

FIG 9

BRICK CHECK-DAM

Maximum Height: 4 to 5 feet.

All brickwork laid in 1:6 cement mortar.

NOTE: A similar dam may be built in stone-masonry.

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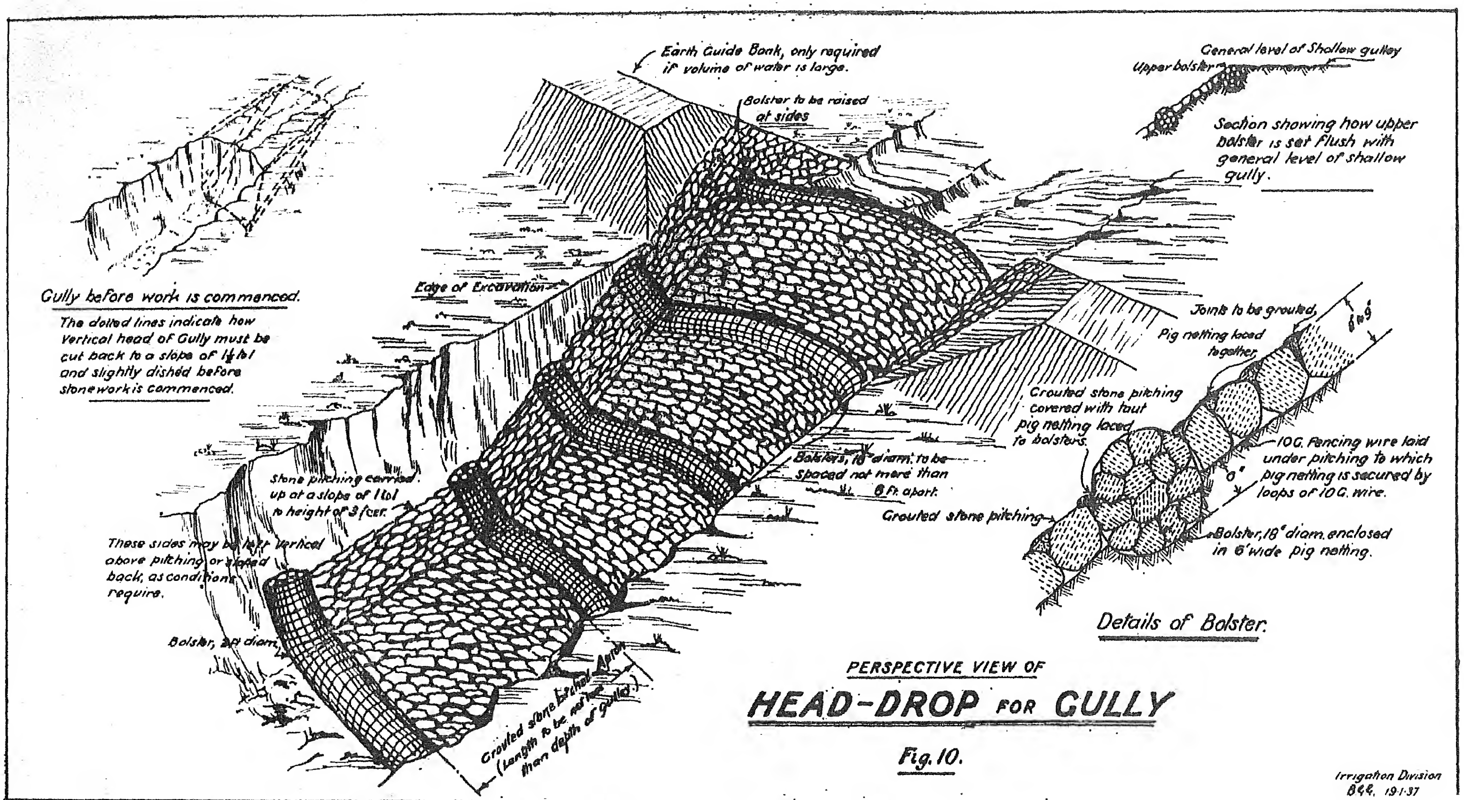
deep, carried a little way up both banks, and the surface "grouted" with 1 : 6 cement mortar. The length of the apron should be $1\frac{1}{2}$ times the height of the drop. For more severe conditions, the apron should be laid in cement mortar and a low cross-wall built at the down-stream edge of the apron, to form a water-cushion. A typical brick check dam is shown in fig. 9.

In connection with aprons, it may be noted that with drops not more than 2 to 3 feet high and built sufficiently close together for the water level at one drop to extend back to the toe of the drop upstream, stone aprons may be dispensed with, or replaced with a mat of a close-growing grass, such paspalum or couch.

Another type of check dam consists of a double fence as previously described, built from 1 foot 6 inches to 3 feet apart according to height, and the space between lined with a packing of long grass, mealie stalks, etc., and filled with rubble, gravel or stones.

Space does not allow of an exhaustive description of all possible designs of check dams, but enough has been said to indicate the type of structure required, and an inventive mind will be fruitful of further modifications to suit particular conditions. Cases of difficulty should be referred to the Irrigation Division.

Earth Dams.—Larger dams may be built if a suitable site is available, and are frequently useful to silt up a long stretch at the lower end of a big gully. For our conditions, they will usually be earth dams, owing to the expense of concrete or masonry in big dams, and a necessary condition of the site will be the existence of a suitable spillway. If the gradient of the gully is not too steep, a dam of this sort will frequently store a considerible volume of water, and in certain cases may qualify for a rebate of a portion of its cost. As each site must be treated on its merits, it is advisable to obtain the advice of an engineer on the spot, and for this reason no detailed description or illustration of the design will be given in the present Bulletin.



PERSPECTIVE VIEW OF

HEAD-DROP FOR GULLY

Fig. 10.

Drops.—The question of check dams is closely connected with that of drops such as are found at the head of a gully or in cases where it is necessary to discharge contour ridges into a deep gully. At such points the bank of the gully is usually sheer or overhanging, due to the undermining action of the falling water, and the problem is to lead the water safely, and cheaply, to the bottom of the gully, which may be very deep, without either causing further erosion or permitting the existing erosion to proceed further.

Means of prevention should first be sought. Firstly, the general precaution of reducing run-off should be examined, by considering the possibility of contour ridging the land above or improving the natural vegetation. Secondly, it may be possible to divert the water before reaching the head of a gully and to lead it in a large drain to a point where it may be safely discharged, such as down a rocky slope.

If these means fail, some form of controlled drop should be constructed. These drops may be of various types, according to the local conditions and the materials available. The fact must be faced at the outset that the construction of a drop in a gully of any size is an expensive matter, but, with correct design and careful supervision and workmanship, satisfactory results should be obtained.

Bolster and Stone Drop. (Fig. 10).—Apart from minor modifications, this type of drop is the one most likely to be satisfactory under our conditions at reasonable cost, and a number of such drops have proved reliable in use.

The first step is to excavate the head of the gully to a uniform slope of 1 vertical to $1\frac{1}{2}$ horizontal. Thus for a gully 10 feet deep, the head of the slope will be 15 feet from the foot (measured horizontally). The bed of the excavated slope should not be level across, but should be *slightly* hollow in the middle, in order to keep the main body of water away from the sides. The sides of the excavation should not be left vertical, owing to the danger of falling in, but should be trimmed to a slope of 45° (1 in 1 slope) for a width of 3 feet at each side. Above this, the sides may be left vertical, or, if the main

channel of the gully is sufficiently wide immediately downstream of the drop, the sides should be trimmed back to a slope of $1\frac{1}{2}$ to 1. The latter treatment is the safer, if feasible.

At the foot of the slope, and at intervals not exceeding 6 feet up the slope, small trenches 6 inches deep should be excavated, to receive the bolsters shown in the drawing. These trenches will be slightly curved upstream, to fit the hollow shape of the excavation, and each should therefore be horizontal throughout its length. At each end the trench should be carried well up the sloping side of the excavation. A 6-foot width of pig netting should then be laid in each trench in such a way that a 1-foot width is left projecting up the slope. Each trench should then be packed with stones to form a bolster 18 inches diameter (see "Bolster" dam). A similar bolster should be laid at the head of the drop, except that the trench should be deeper in the middle, so that the top of the bolster will be flush with the ground above the gully. At the foot of the drop the bed of the gully should be levelled for a distance equal to the depth of the gully, and at this point a bolster 2 feet diameter should be laid as a check dam, to form a water-cushion.

Between each pair of bolsters, wires (10 gauge galvanised) should be laid on the ground about 2 feet apart, running up and down the slope, and secured to the bolsters at each end. These wires are later to be secured to the pig netting laid over the stone-pitching (see Detail, fig. 10). The loops of wire should be put in place as the stone work proceeds.

The area between each pair of bolsters should then be pitched with large stones carefully and closely packed together, not flat but ends downwards, and, if the spaces between stones are too large, smaller stones may be well driven in with a hammer.

The stone-pitching should then be covered with a width of 6-foot pig netting, laid horizontally between each pair of bolsters, and secured to the upper bolster and to the strip of netting projecting from the lower bolster. The netting should be tightly stretched and fastened down by the loops of wire brought up through the stone work.

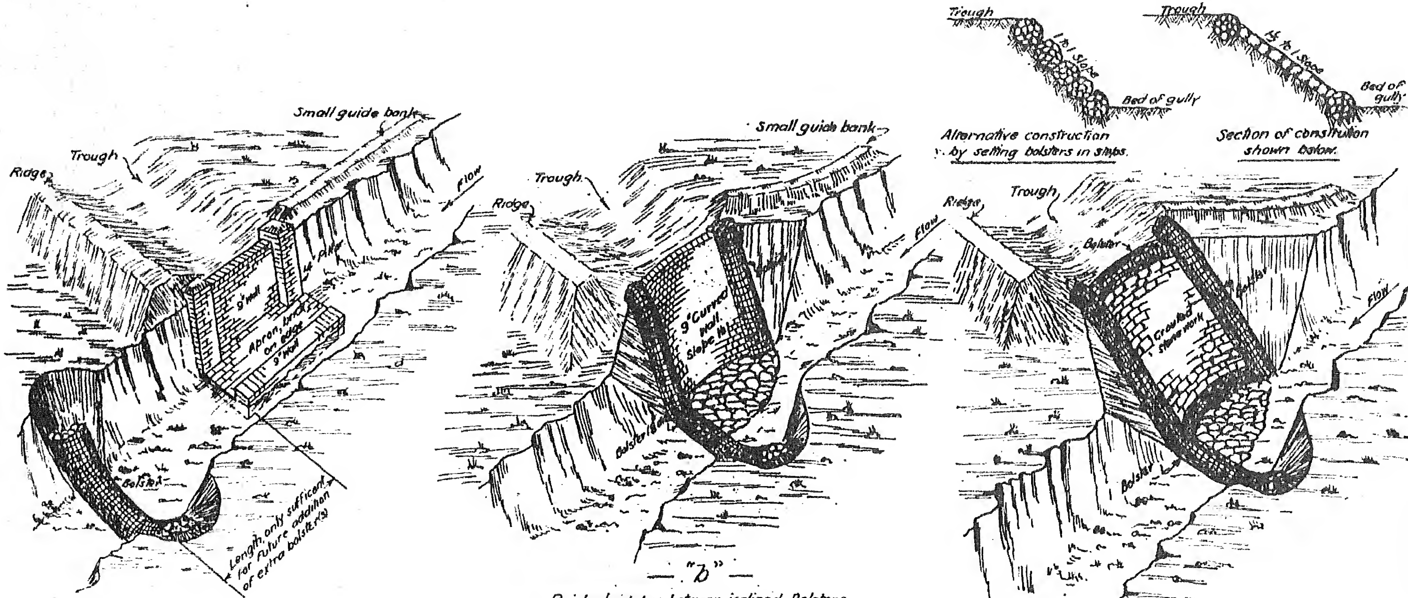
The joints of the stone work should then be filled with a "grout" of fine concrete, consisting of 1 cement : 3 sand : 6 small broken stone, well worked in and embedding the pig netting whenever possible. It may often be advisable to continue the grouting over the top of the bolster at the head of the drop in order to prevent water finding its way through the bolster and under the stone-pitching. This bolster may well be replaced by a brick or masonry wall laid in 1 : 6 cement mortar, in certain cases.

If the volume of water reaching the gully is large, it will be necessary to prevent its spreading, and to this end the earth guide banks shown on the drawing should be built and the stone-pitching carried up the slope of the ends of the banks.

The treatment of the head of a gully should be accompanied by the construction of a series of check dams at the proper intervals down its course, and/or the sloping and planting with grass of the sides of the gully. The object to be aimed at is the eventual partial filling of the gully, particularly at the head.

Contour Ridge Outlets.—Allied to the subject of drops at gully heads is that of making outlets for contour ridges into gullies, where this is unavoidable. When the gully or storm-drain is not deep, the best form of drop is a brick and cement wall forming the face of the drop. At the crest the opening should be not less than 6 feet wide, and on each side of the opening a brick pillar should be built, projecting from the face of the wall, and carried a few courses above the crest. Earth banks should be built to prevent water cutting round the ends of the wall. At the foot of the drop an apron, preferably sunken, and a cross wall, should be placed to prevent a pothole forming. This drop is shown in fig. 11(a).

When the gully is deep, it will usually be more economical to combine the discharges from several contour ridges at one point, rather than build several small drops. This can be done by leading the water from two or three ridges successively



—"a"—

Bricks laid in cement mortar

Recommended for drops not exceeding 4' deep

"b"

Bricks laid dry between inclined Bolsters

—"c"—

Bolster & Grouted pitching or Bolsters set in steps

Fig. 11

RIDGE OUTLETS INTO GULLY.

THREE METHODS OF CONSTRUCTION

Irrigation Division
BCC 21·1·37

into a broad shallow drain parallel to the gully, and then making a point of entry for the combined flow. Various devices tried in the past, such as chutes of corrugated iron, tobacco flues, or brickwork, have not proved successful. The best types of drop would be on the lines of those shown in fig. 11 (b) and (c), although other designs will suggest themselves according to materials available and local conditions. Fig. 11 (b) shows a drop made of bricks laid dry on a sloping hollow trough excavated in the bank of the gully, the width being at least equal to the width of the trough of the contour ridge. The slightly hollow shape of the trough should not be exaggerated, in order to facilitate laying the bricks, which are to be laid as "headers." The sides of the trough should be protected by brickwork, or by stone-and-wire bolsters, as shown. Fig. 11 (c) shows a type of drop similar to a section of that shown in fig. 10. Alternatively, the drop may be cut in steps 18 inches deep by 18 inches wide, on which are laid bolsters 2 feet in diameter. The space between each bolster and the vertical face of the step should be tightly filled with rubble and stones or long grass and trash.

In addition to an apron at the foot of the drop, it is advisable to build a check dam across the gully immediately down- stream of the drop. If the check consists of a bolster it will be possible to raise it by the addition of one or more bolsters in subsequent seasons, and sufficient room should be left for this purpose.

Meandering.—A gully that follows a winding course is more troublesome than a straight one, even after the gradient has been flattened by building a sufficient number of check dams. At the outside of each bend the impact of floods undermines the bank and creates a sheer face on which no vegetation will grow. (See fig. 6.) In planning a system of check dams a check should be placed immediately *downstream* of a sharp bend, and not at or above it, so that the velocity of the water is reduced at the weak spot. In severe cases the foot of the unstable bank should be revetted or protected with posts, bolsters or stonework, and while held in this way no time should be lost in sloping off the bank and planting to a binding

grass. Dense vegetation, such as willows or poplars, etc., should be planted at the foot of the banks and in the silt held up by the bolsters.

Lateral Gullies.—The worst feature of a gully or abandoned road is often the numerous side gullies which are formed (see fig. 3). If the gully is deep and the side gullies large, it will be necessary to construct drops of the types shown in figs. 10 and 11 at each point of entry. If the main gully is shallow and the banks not very steep, it may be possible to cut diversion drains on a small gradient to lead the water into the gully at some point upstream. If nothing is done, the lateral gullies will grow and may well eclipse the original gully in size and damage.

(*To be continued.*)

THE CONDITIONS GOVERNING THE HIRE OF GOVERNMENT BORING MACHINES.

The conditions under which farmers and other private applicants may obtain the services of the Government drilling machines for the purpose of boring for water are defined in Government Notice No. 86 of 1934 (as amended) and copies of these regulations are obtainable on application to the Director of Irrigation, Box 387, Salisbury.

The following fuller details regarding certain sections of these regulations are published for general information, as applicants in the past have sometimes complained that regulations of this nature are not sufficiently self-explanatory and that they do not know what their commitments are likely to be if the services of one of these machines is obtained.

Charges Involved (Section 21).—Charges for the drill are on a daily and not a footage basis, a day being reckoned as a $9\frac{1}{2}$ working-hour period. The costs involved in hiring one of the machines comprise—

(*a*) a charge of £3 per day whilst the drill is being set up or dismantled and for carrying out a pumping test (12 hours or under);

(*b*) a charge of £6 per day whilst actual boring or essential operations in connection therewith are in progress;

(*c*) a charge of £5 per day for any delays due to the applicant not supplying fuel, water or transport;

(*d*) the cost of casing put down to line the borehole; the cost of casing varies according to prices prevailing at the time, but may be taken to range from 3s. 10d. per foot for 5-inch to 4s. 6d. per foot for 6-inch diameter casing.

In addition, the applicant has to provide fuel and water for the operation of the drill, and transport for the drill and equipment from the nearest railway station or such other con-

venient point as may be determined by the Chief Engineer, except where an internal combustion engine is being utilised for the operation of the drill or it is hauled by a tractor. For these charges see the sections on Transport (15) and Fuel and Water (16). In the case of farmers who have transport available, the provision of the additional services as detailed above does not entail any actual out-of-pocket expenses.

Average Costs.—The list of charges detailed above appears formidable, but in actual fact the boring costs do not, on the average, amount to a considerable sum, and are cheaper than sinking wells to a corresponding depth in similar formation.

The only cases in which complaints are received as to the high cost of boring are those where more than one borehole has had to be sunk on a property before a supply is obtained.

During the last ten years the total footage drilled for private applicants has amounted to 44,232 feet, at an average cost of 17s. 11d. per foot, *including the price of casing supplied*. This footage represents 363 boreholes which have been sunk for private applicants, of which 73 per cent. have yielded useful supplies of more than 2,500 gallons per day at an average depth of 122 feet.

From this it will be seen that the total cost per borehole is under £110, and it will be admitted that if all boreholes could be guaranteed to be sunk for this figure, there would be no cause for complaint. Unfortunately, however, there can be no guarantee of this nature, as the costs vary considerably in different formations, and during the period in question the costs for individual boreholes have varied from 8s. 4d. per foot to 36s. 8d. in extreme cases; but in the great majority of cases it is safe to assume that the cost per borehole will not exceed £150.

Methods of Payment (Section 3).—There are six methods by which payment of the boring charges may be made, *viz.*:—

(*a*) *By payment of a cash deposit of* £75 and such additional sums as may become due during the progress of operations.

(*b*) *By payment on demand of the full amount* after completion of the work.

(*c*) *By payment of monthly instalments* over a period not exceeding two years free of interest. If any balance is outstanding after two years interest at 5 per cent. per annum will be charged.

(*d*) *By payment of a cash sum* on completion of the boring operations and the balance by instalments under the same conditions as in (*c*).

(*e*) *By an advance from the Land Bank*: In these cases applicants have to submit a certificate from the manager of the Land Bank stating the amount of the advance that has been approved.

(*f*) *By an advance from Irrigation Loan Funds*: An applicant who wishes to take advantage of these facilities should make application on a separate form for a loan to cover the estimated cost of the boring charges, the necessary forms being obtainable from the Irrigation Division.

These loans are granted normally subject to 4½ per cent. interest per annum and are repayable in annual instalments, the period of redemption varying from 5 to 20 years, dependent on the amount of the loan. The first annual instalment is usually called for about a year after the completion of the work.

The security required for an irrigation loan is either two personal sureties who are holders of immovable property in Southern Rhodesia; or failing that, the loan will be registered against the title deeds of the farm at no extra expense to the applicant.

All applications for irrigation loans have to be approved by the Governor-in-Council.

Classes of Government Drills (Section 13).—The standard equipment at present supplied consists of a percussion or "jumper" drill for boring through soft formation, and a

rotary shot drill for boring through hard rock. Either drill may be brought into operation as required. Two types of power driven units are in use, steam and crude oil. The Director of Irrigation reserves the right to send whichever type of drill is the most convenient.

The rate of drilling in soft formation with the percussion drill is generally from 20 to 40 feet per day, and in rock formation with rotary drill from 2 to 8 feet per day.

Transport (Section 15).—The rotary and percussion drills each require a full span of 16 oxen or the equivalent to transport them. In addition to the plant itself, there are usually two full-sized wagon loads of equipment, such as tanks, casing, tools, etc., and the necessary wagons and oxen must be provided by the applicant for their conveyance. A further span of from four to twelve oxen, depending on the condition of the road to be traversed, will be required for the caravan occupied by the drill foreman in charge of the plant.

In the event of a drill being hauled by a Departmental tractor, a charge of 10s. per mile will be made.

A wagon is provided with some of the outfits for riding wood and water during boring operations, and when such is available it may be placed at the disposal of the applicant for transporting the equipment. The applicant is expected, whenever possible, to provide the necessary service under this heading, either with his own transport or by means of transport hired or otherwise obtained by himself. Where he is unable to do so, the Government will hire or supply the necessary transport from the most convenient source and debit the cost thereof to the applicant.

Fuel and Water (Section 16).—With the steam-driven drills the amount of fuel required depends entirely on local conditions, but the applicant should be prepared to provide up to a cord of wood per day for each day the drill is actually working. The wood should be perfectly dry and of good heat-

giving qualities. In the event of suitable wood not being available, coal can be used, in which case approximately six bags of 200 lbs. each will be required per working day.

During boring operations a quantity of water is required to operate the drill. Approximately 600 gallons is required for percussion drilling and up to 2,000 for shot drilling, of which 400 gallons are required for use in the boiler and should be of the purest quality obtainable. For the actual boring, practically any water can be used, providing it does not contain too much mud or silt. The plant is provided with square tanks of 200 gallons capacity, which can be conveniently carried on a wagon for conveyance of water from the source of supply to the drill.

In the event of a drill equipped with a tractor or crude oil engine being detailed, a charge of 10s. per day, for fuel, will be made.

Geophysical Prospecting.—Applications for the hire of a drill must be accompanied by an application for Geophysical Prospecting (Government Notice No. 871 of 1936), together with a cheque for £2 2s. and "Schedule A" completed. In the event of boring being undertaken on the site selected, the deposit will be deducted from the boring account. A site selected by this means assures the applicant that, in the event of a supply not being developed, his application for a rebate will be recommended. If no favourable site is selected and the applicant still wishes to bore he must sign a form agreeing not to apply for a rebate.

Rebates (Section 24).—Applications for rebates will be considered if the site is approved by the Director of Irrigation, or his authorised deputy, if

More than one borehole has been sunk on a property without adequate supply being developed, or

A yield of less than fifty gallons per hour has been developed on urban residential plots.

No rebate will be considered if the applicant wishes to bore in the bottom of a well, and all applicants are advised against this practice.

Applications for rebates should be made upon the receipt of the account showing boring charges.

General.—An application for the hire of a drill must be submitted on the prescribed form, and it may be noted that the declaration of surety need only be completed by the applicant when he is specially requested to do so.

Since the charges are based on a daily rate, it is in the applicant's own interest to render all assistance possible for the expeditious carrying on of the operations.

The drill foremen are instructed to submit their weekly reports to the applicant for signature before forwarding them to the Irrigation Division, and applicants are advised to satisfy themselves that the information contained therein is correct, as discussion as to their accuracy cannot afterwards be entered into.

SOME FACTS AND COMMON FANCIES
CONCERNING DECLARED TOBACCO PESTS.

By M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.

Most tobacco growers and warehousemen are by now fairly well acquainted with the "Tobacco Pest Suppression Act, 1933" and its regulations. The Act superceded a previous Act of 1931, and its objects are to prevent the increase and spread of certain insect pests and diseases of cured and growing tobacco. Some, however, do not appreciate the fundamental facts on which the Act was based.

At present the following are declared "pests" under the Act:—

The Stored Tobacco Worm, *Ephestia elutella*, Hubn.
The Stored Tobacco Beetle, *Lasioderma serricorne*, Fab.
The Tobacco Whitefly, *Bemisia rhodesiaensis*, Corb.
The virus disease known as "Tobacco Leaf Curl."

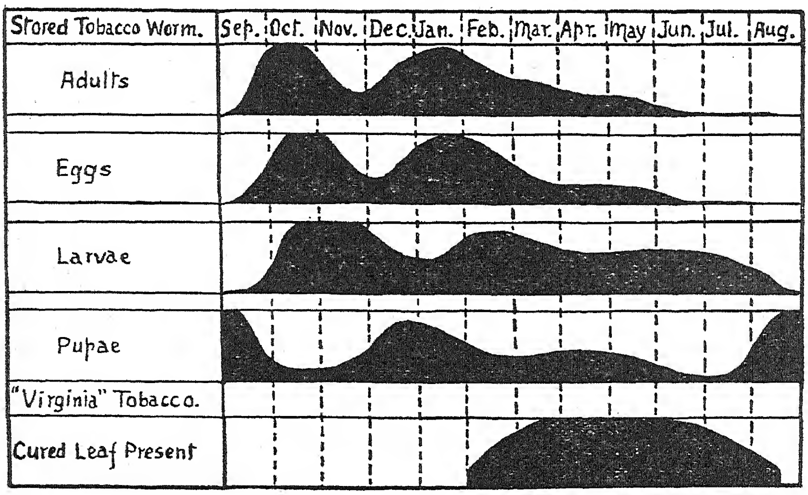
CURED TOBACCO.

The life histories of the two pests of cured tobacco were detailed in the *Rhodesia Agricultural Journal*, April, 1932, and illustrations given. Some growers apparently do not understand that the two pests represent entirely different species, that they do not interbreed, and that no stage of either can develop into any stage of the other. The commonest error is that "The beetle turns into the moth." The developmental stages of the two insects are (*a*) Tobacco Beetle: egg; larva (grub); pupa; adult (beetle). (*b*) Stored Tobacco Worm: egg; larva (caterpillar); pupa; adult (moth). A beetle can no more change to a moth than a horse to a human, or a fowl's egg hatch to a sparrow.

Now, it is fortunate that the seasonal life histories of the Stored Tobacco Worm and the Tobacco Beetle are somewhat similar, and more fortunate that the handling of the Virginia

tobacco crop can easily be modified to the disadvantage of the insects. In considering the facts, which are as follows, let us examine the life history of the Stored Tobacco Worm, which is the more important pest from the point of view of overseas markets.

The insect, after a largely dormant period, becomes very active in September, when a mass emergence of adults commences. Almost at once egg-laying starts, the eggs being deposited on any suitable medium for the development of the young. Another generation starts in December and January, after which there is a certain amount of overlapping of generations, owing to the inequalities in individual development, and any stage of the insect can be found until autumn. By September when the mass emergence occurs the tobacco sales are over for the season and in nearly every case it is quite feasible to clean up properly all the tobacco sheds, barns, grading rooms and heaps of tobacco refuse, and thus to starve the progeny of any pests that may be present.



Comparison of approximate seasonal Abundance of Stored Tobacco Worm (*Ephestia elutella*, Hubn.) and cured Virginia Tobacco on a well managed farm.

But cleaning must be thorough. Small holes and cracks in wooden floors swallow up scraps of tobacco throughout the grading season, and these accumulate into little heaps of tobacco. This tobacco, in the humid atmosphere that prevails under the floor, often remains in a very suitable condition for

the development of stored tobacco pests. Special attention should, therefore, be paid to such places. Similarly, cracks in cement floors, spaces and crevices under machinery such as presses, and places such as slits under window sills, should be thoroughly cleaned out. Even rafters and the tops of walls should not be forgotten. September can be made a critical month in the life histories of both of our pests of stored tobacco.

The practice of complete disposal of the crop and thorough cleaning before the end of August is an excellent weapon in possession of the growers for the prevention of an infestation by tobacco pests, or for the eradication of a small, possibly unsuspected outbreak. This method was completely effective in a large, infested warehouse in 1930-31. The earlier disposal and cleaning can be accomplished the better, as it will destroy the immature stages of both pests and diminish the number of sexually mature adults that subsequently emerge, or prevent their emergence completely.

Portions of the Act, and of Regulations under the Act, were designed especially to take advantage of the fortunate concurrence of the "off season" in the tobacco sheds, and the main active periods of tobacco pests, but to gain the fullest advantage one must start *early*. As will be seen in the accompanying figure, the moths of the Stored Tobacco Worm have not yet commenced to lay eggs by the end of August, and disposal and cleaning up should be completed by that time.

The wisdom of this procedure can be better appreciated when it is explained that *not all* of the progeny of the September generation of moths go to form a new generation in December-January, but some of them remain in hiding as fully fed caterpillars until they pupate at any time between January and the following August. That is to say, they may remain hidden until the new crop is being harvested, and then pupate and emerge as egg-laying moths infesting the sheds. In fact, the artificial temperature and humidity in grading sheds at this time is quite likely to be responsible for the resumption of development of these long-resting caterpillars.

The starvation of the progeny of the adults that emerge in September can usually be carried out only by growers of Virginia type tobacco. The grower of Turkish type cannot

aim at starving this generation of young insects, as his handling of the crop may not be completed until November or December. His method must be to prevent the appearance of progeny of the older generation by killing off the insects in the stages in which they are present during early August, namely, fully grown larvæ, and pupæ. Some of these will be hiding in bales, but most of them will be in the crevices of walls, etc. Adults must not be allowed to emerge. A thorough cleaning by the middle of August, followed by another as soon as the crop is finally disposed of, will go a very long way towards the prevention or control of the pests.

Growers of either type should not regard these spring and summer cleanings as their complete effort at control. A good cleaning before the new crop is brought in, and periodical cleanings during the curing and grading season, should be included in their programme.

The notion that pests of cured tobacco can develop only on cured tobacco is entirely erroneous. Over seventy food sources of the beetle have been recorded, and the Stored Tobacco Worm attacks a wide range of products, including peanut products and maize meal. It is, therefore, highly inadvisable to keep alternative sources of food in sheds used for tobacco, and such sheds should be removed as far as possible from homestead and storage rooms where grain or meal is kept.

The question may be asked, "Why all this fuss when so few sheds in the Colony have ever been infested?" There are two answers. One is that, although the Act has undoubtedly been successful in preventing outbreaks and the spread of these pests, the intelligent use of known facts by growers, etc., is of inestimable value to themselves individually, besides ensuring automatic and unburdensome compliance with the Act. The "intelligent use of known facts" may be summed up in the one word "Hygiene," or in the more explicit direction, "*Dispose of the whole crop and clean up thoroughly by the end of August.*"

The other answer, trite as it may be, is that prevention is better than cure. Some sheds *have* become infested, and in certain cases the cure has cost the owners more than the cost of ten or even twenty years of prevention.

Growers who insist on retaining some tobacco for their own purpose should consult the *Journal* article mentioned above. An alternative method not mentioned in the article is to pack the tobacco loosely in a barn and heat up the barn, say, once in two months for a sufficient period to ensure that a temperature of 125° Fahrenheit is maintained for 24 hours in the *interior* of the tobacco. Normally, tobacco that would be damaged by this treatment would not be retained after the sales are over.

GROWING TOBACCO.

The portion of the Act dealing with growing tobacco has been greatly appreciated by many growers. It aims at the control of leaf curl diseases by the prevention of the increase and spread of its vector, the Tobacco whitefly, *Bemisia rhodesiaensis*, Corb. Outbreaks of the insect and disease have been definitely traced to neglected lands, even those on neighbouring farms, and there can be no doubting the intimate connection between these pests and such lands. (See *Rhodesia Agricultural Journal*, March, 1934).

The whitefly overwinters by breeding slowly throughout the winter on tobacco and a number of other plants. Tobacco is the most important of these, as it is known that it can maintain leaf curl even in the re-growth from plants cut off under the soil, and on a neglected land tobacco is the most numerous of dangerous plants. Other plants attacked by whitefly may possibly suffer from the disease or act as carriers of the disease which can be transmitted from them to tobacco, but no definite discovery has been made in the Colony along these lines. In order to prevent to a very large extent the winter propagation of whitefly and the heavy spring increase in its numbers, all tobacco plants, including volunteers, old plants, roots and re-growth, whether near lands or seedbeds or elsewhere on the farm, should be destroyed as early as possible. The need for promptness is intensified by the fact that control must be effected not only for the following field crop, but well ahead of the time the young plants come up in the seedbeds. The regulations make the up-rooting and destruction of all underground portions of the plant compulsory.

In the control of whitefly and leaf curl, let "Hygiene" again be the watchword. Hygiene has been shown to be often more simple in agriculture than in medicine, and just as effective. A simple plan for the cleaning up of tobacco lands was given in the *Rhodesia Agricultural Journal*, November, 1932, and was based on the statement that "*cultural practice should be modified as far as possible to ensure the complete eradication of volunteer plants as soon after harvesting as can be accomplished.*" It applied chiefly to lands, though seedbeds were also mentioned. The plan has been followed by many growers with gratifying success, and is in accordance with good tobacco culture.

As regards seedbeds, the eradication of unrequired plants is simple, but it is surprising how many growers neglect their old seedbeds once they have removed the plants they need. To combat this, at least one farmer (and probably more than one) has made his treatment of used seedbeds a hobby that ensures their cleanliness. He sows one bed with the seeds of eucalyptus or other trees, seedlings from which are planted in a single row down the middle of each discarded bed as early as possible. The remaining seedlings are planted elsewhere on the farm. His interest in the young trees ensures the eradication of tobacco plants and weeds in and near the beds, it prevents the beds from being used again for several years, it makes additional use of ground already cultivated, and it is at least a gesture towards reforestation.

The conviction of certain growers farming in the higher altitudes that whitefly cannot infest their farms on account of the cold should not be relied upon and made an excuse for careless work. A tale of this sort soon circulates and may lead to trouble. In fact, whitefly has already been seen on some of the exposed upland farms, and also in other areas at even higher altitudes. Even if winter temperatures are too low on the lands, there are always sheltered spots available where the insect can continue to breed throughout the winter.

One chief cause of trouble in combating the increase and spread of whitefly is the evacuation of rented tobacco farms by lessees or temporary growers. On these farms tobacco plants may be left standing or possibly be cut off below the surface of the soil and left to produce a vigorous re-growth. But here,

growers can easily take steps to have the matter rectified by reporting the circumstances to the police. In September, 1933, all European members of the Britsh South Africa Police were gazetted as inspectors under Part II. of the Act, which deals with pests of growing tobacco. This does not mean that the police will be called upon to make decisions on technical matters, but it means that an opportunity of reporting dangerous re-growth, etc., is readily at hand. Usually the plants are removed as soon as possible after being reported and the question regarding who pays for the work is decided later.

In general, the administration and application of the Act, both as regards pests of cured and of growing tobacco, have been welcomed by growers as a means of protection both for themselves and from their neighbours, and have proved remarkably successful. Incidentally, the hygienic methods advocated by the Department or prescribed by law have the additional benefit of assisting in the control of pests of tobacco other than those declared as pests under the Act.

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THE USE OF LIME.

By S. D. Timson, M.C., Assistant Agriculturist.

The reduction in price of and freight on agricultural lime announced elsewhere in this Journal have opened up a very much wider field of usefulness for this very important soil constituent.

The maize farmer will find a moderate dressing of one ton per acre on those soils which have been under cultivation more than 15 years well worth a trial. The result of the experiments carried out at the Agricultural Experiment Station, Salisbury, indicate that an application of lime at the rate of one ton per acre may be expected to give an increased return of 5.40 bags per acre of maize over the three year period following its application, and it is possible that still further benefits, both direct and indirect, would result in subsequent years.

In addition to this actual increase in yields he should obtain the indirect benefits resulting from the improvement in the physical condition or tilth of the soil, which makes ploughing easier and reduces wear and tear on implements, and also assists in obtaining a planting tilth earlier in the season with its attendant benefits.

Lime also fixes the humus in the surface soil, and prevents it being dispersed and washed down to the lower levels. This is of considerable importance in our soils, which are so deficient in humus, and suffer from the effects of heavy storms of rain.

Another important function of lime in the soil is that it stimulates the action of the beneficial bacteria which decompose organic matter, such as green manures and stubbles, and also those types which fix free nitrogen from the air. There seems little doubt that the latter are chiefly responsible for the supply of nitrogen to the maize crop during the growing period.

Lime also protects the potash in the soil from loss by leaching, and this action should be of particular value on the sandy soils of the Colony, which are generally very deficient in this important plant food.

The moisture-retaining soils of the so-called sandy vlei type, on which the bulk of our wheat is grown, are normally very acid, and since it is well established that wheat thrives best in a slightly alkaline soil it is reasonable to presume that the rectification of the acidity of our vlei wheat soils by the addition of lime periodically should result in the increase of the yield of wheat grown thereon.

The results of experiments carried out by this Department on this point indicate strongly that this is the case. Applications of 1,000 and 2,000 lbs. of agricultural lime per acre, whether applied alone or with manure and artificial fertilisers, have given markedly increased yields of wheat on granite vlei soils at Marandellas and Salisbury.

It has also been noted that the wheat on those plots receiving lime have been very much less affected by rust than the wheat on plots not receiving lime.

Wheat farmers are recommended to test the effect of applications of agricultural lime at the rate of one ton per acre in addition to the application of phosphate and potash. It should be applied as soon after reaping the wheat as possible, and ploughed under.

The great potentialities of our sandy vlei soils for producing high quality pasture all the year round, and particularly in winter when it becomes so necessary, have never been appreciated in this Colony, and this Department is endeavouring to focus the attention of farmers on this very important matter.

It is already clearly demonstrated that valuable winter pasture can be maintained on such soils by the planting and proper treatment of such indigenous grasses as Swamp Couch, Creeping False Paspalum, and Native Paspalum, and also the exotic *Paspalum dilatatum*. The combination of wild white clover and possibly other types with these grasses, will

largely increase the feeding value of such pastures, and applications of agricultural lime to the soil, in addition to phosphates and potash, will go far to ensure the healthy growth of the clover, whose need of lime in the soil is well known.

A series of demonstration plots to illustrate this is being established on granite wet vlei soil in the Rusapi district by this Department with the co-operation of the Rusapi Farmers' Association, and it will be possible in a few years to make definite recommendations concerning the use of lime and fertilisers on pastures on soils of this type.

In the meantime those farmers who possess such soils are strongly advised to test mixtures of the grasses mentioned above with wild white clover, and to apply a dressing of 2,000 lbs. of lime per acre to the soil before planting them.

Farmers who are in doubt as to the acidity of their soils, or as to the advisability of applying lime, should send in representative samples of their soils for analysis by the Chemistry Branch of this Department.

A POISON BAIT FOR YOUNG LOCUST HOPPERS.

From the Entomological Branch.

Poison-baiting with a mixture of arsenite of soda ("locust poison") and maize meal against Red Locust hoppers has been reported successful in the Union of South Africa, and is becoming a standard official method of control. Some preliminary experiments were carried out by officers of the Department of Agriculture in Southern Rhodesia last year. Promising results were obtained against young hoppers in standing crops, where spraying with a solution of arsenite of soda is undesirable.

Those who wish to try the bait in their lands, or elsewhere, should adopt the procedure described below.

The following paragraphs, except the first, are quoted (in places slightly altered) from Circular No. 26, Union Department of Agriculture and Forestry, November, 1936.

Mixing the Dry Ingredients.—Mix thoroughly one pound weight of arsenite of soda powder with 92 lbs. of maize meal. The poison should be finely powdered and dry, and should contain no lumps. The meal, also, should be dry and without lumps.

Moistening.—It is advisable not to moisten the bait long before one expects to use it, since the bait gives the best results if scattered immediately after moistening. Spread the bait amongst the locusts in as wet a state as possible, without having it so wet as to fall in lumps.

Moisten the bait in a metal trough or drum, on a bucksail, on a wooden floor, or on the ground. It will not matter if a small amount of soil gets mixed with the bait. Any article used in moistening the bait will contain poison and

should therefore be thoroughly washed. If the bait is moistened on the ground, the place so used must be well dug over to bury the poison that has soaked into it.

In moistening the bait, follow the methods employed in mixing sand and lime for building purposes. Throw the dry bait on the bucksail in a heap. *First of all mix the dry bait thoroughly* by working it over with shovels.

Make a cavity in the top of the heap and pour a portion of the water into it. Work the water in by means of the shovels. Then add the rest of the water and continue working over until all parts are well moistened. If any lumps are formed break them up by means of the shovels.

Store the moistened bait in the shade or keep it covered with wet bags.

Amount of Water to be Added.—Use sufficient water to moisten the bait thoroughly but do not soak it in water. When the bait has been properly moistened, a handful when squeezed gently should produce five or six drops of water only.

For 100 lb. of bait about 8 to 10 gallons of water will be required, depending upon the nature of the bait carrier.

Spreading.—The bait is expensive, therefore use the minimum amount required. *If too much is spread there is danger of stock poisoning.*

The amount required per acre will vary according to the height and density of the vegetation. On comparatively bare ground, or in vegetation up to one foot in height, about 60 lbs. of maize meal bait will be sufficient. In tall, dense vegetation the dosage may have to be increased to 120 lb. maize meal (dry weight) per acre.

An acre is approximately 80 yards by 60 yards.

Spread the bait thinly and evenly over the area occupied by the band of hoppers. The method followed in broadcasting wheat seed is the best: Take a handful of bait and spread half on your right side. To do this easily, the first movement of the arm must be made with the left foot going forward, opening the thumb and the first two fingers. To spread on the left side the second movement of the arm must be made while the

last two fingers are opened, and should coincide with the forward movement of the right foot. One handful should be sufficient for the two movements. Too much bait should not be taken in the hand. One man can spread a strip about 8 yards wide. Where a large band is treated, the spreaders should, therefore, be at least 8 yards apart. *Lumps and small heaps are extremely dangerous to live stock.* Spreading should, therefore, be done carefully so as to leave no chance of cattle picking up bait.

When the dosages per acre has to be increased, do not attempt to do this by taking larger handfuls, as this will result in dropping lumps of bait. Rather place the spreaders closer together, so that their baiting strips overlap, as required.

In spreading bait for the destruction of hoppers of the red locust, it is desirable, especially in tall, dense vegetation, to throw the bait with some force, so that the particles of bait may stick to the foliage of the plants. The burning that will result on growing crops will be so slight as to be negligible.

It must be remembered that the bait should be so moist, when it is broadcasted, that when a handful is gently squeezed it will yield several drops of liquid.

The hoppers often pack in very dense masses on a few bushes, when camping for the night. It is a mistake to put a large amount of bait in these dense clusters and to neglect the surrounding places where the hoppers are more thinly scattered. It is important to bait the whole area occupied by the hoppers uniformly; those in the dense clusters will spread out before they begin to feed.

Also bait a narrow strip of ground all around the band of hoppers, say, 3 yards wide if the band is about 15 yards wide, and a narrower strip in the case of smaller bands.

When should Bait be Spread?—It is of the utmost importance to note that the bait cannot be employed against hoppers of the red locust in the same way as it is used against the brown locust. When the red locust hoppers are on the march, during the warm parts of the day, *they cannot be stopped by scattering the bait amongst them.* They will not stop to feed on it.

Therefore, in baiting hoppers of the red locust, *spread the bait when the hoppers are least active*, that is, late in the afternoon, during the night, or early in the morning. Try to disturb the hoppers as little as possible. If the band is small or narrow enough, it is better to walk through it, but to scatter the bait amongst the hoppers from the edge of the area occupied by them. They will drop to the ground as the bait is scattered, but this does not matter; after the work has ceased they will gradually climb on to the plants again.

It is useless to spread bait during rain or when heavy rain is likely to fall within a few hours. Cloudy weather will in itself have no adverse effect on the efficacy of the bait, and a very slight drizzle will also not do much harm. During very cold weather the hoppers will not feed on the bait to any extent. The presence of dew is an advantage, since it keeps the bait moist and tends to make the hoppers less active, so that they remain for a longer period on the baited area.

Age of Hoppers to be Baited.—During the first 24 hours after they emerge from the egg the hoppers do not feed, therefore the bait will not be effective against hoppers under 24 hours old. It is, however, very desirable to bait the hoppers on the egg-deposit or very close to it. Hatching usually continues for a number of days from the same egg-package. Therefore the egg-deposit should be kept under observation, and bait should be applied as soon as large numbers of hoppers are present that are 24 hours old, or older. After two or three days it will be necessary to bait the area of the egg-deposit again, for hoppers hatching some time after the first application of bait. Under more or less moist conditions the bait should, however, continue to be effective for several days.

Hoppers that are on the point of moulting (shedding their skin) will not feed on the bait. It has, however, been found that they take it very readily immediately after the moult. Therefore a very good time to bait a band of hoppers is when, say, 80 per cent. of the hoppers have just moulted. They will then tend to stay on the baited area and a very good kill be obtained.

Hoppers in the 1st, 2nd and 3rd stages of development are more readily killed by means of bait than older hoppers. The

older hoppers are more restless, and very active, and they are inclined to trek off the baited area quickly. It is, therefore, essential to locate all egg-deposits, and to kill the hoppers as soon as possible after hatching.

Results.—If hoppers take the bait well they will show signs of diarrhoea approximately two to four hours afterwards on a warm day. Usually they do not trek very far from the feeding place and they die, in most instances, a couple of yards from the spot. After 24 hours approximately quarter to half of the swarm should be dead or dying, and after 48 hours approximately nine-tenths should have been destroyed. If after three days a substantial number of the hoppers are left and are healthy, *i.e.*, showing no signs of diarrhoea, they should be baited again. The poison in the bait works slowly and one should not expect all the hoppers to die within an hour or so.

Dangers.—If bait is used according to these instructions no harm will be done to domestic animals or plants. If lumps and heaps of bait are left lying on the veld, domestic animals will pick up the bait and get poisoned.

Care should be taken, therefore:—

(1) that no lumps are left in the bait;

(2) that the bait is spread thinly and that no lumps or heaps are left which can be picked up by livestock;

(3) that the baited area is inspected and that all lumps and heaps are picked up; and

(4) that animals are not allowed to consume moist or dry bait while in bags or tins or while spread out to dry.

THE PROBLEM OF SOIL CONSERVATION

ON LANDS ADJACENT TO MAIN ROADS.

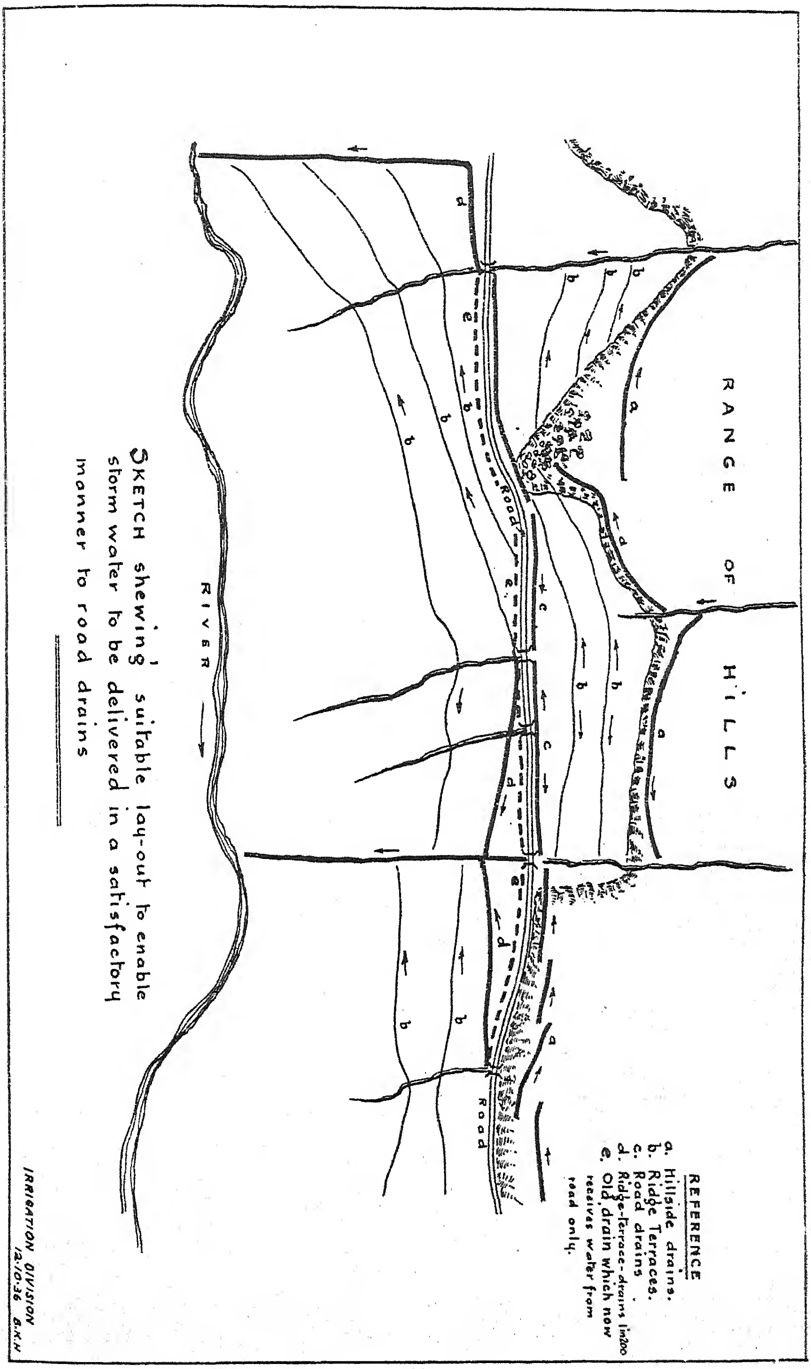
THE ADVANTAGES OF CO-OPERATION WITH THE ROADS DEPARTMENT.

Every year great damage is done to the roads by silt laden water. The removal of this silt is costly. Road drains fed with silt laden water either carry the silt when they have a gradient so steep that the drain scours or else the drain chokes up and breaks. Under these circumstances the drains must always be short on gentle slopes, necessitating innumerable culverts, or the formation of bad roadside dongas on steeper slopes.

In many cases it is quite a simple matter to plan the soil conservation works on the lands above so that clean water is taken to the most convenient natural water courses or to recognise a donga as such, every 1,000 yards.

Road drainage is thus simplified considerably, and it is then generally quite simple and cheap to arrange the road drains so that the catchment on the road itself is taken to these natural water courses or dongas at intervals of 1,000 yards. Before this water just poured down on to the road and had to be got across in the same disorderly manner at frequent intervals, to do great damage to the lands below.

The Roads Department are only too keen to reduce the number of culverts and inverts, and they are willing to share the cost of the work necessary to make this possible and also to dispose of their own water in a manner that is best for the lands below. As for the water which comes on to the road, they are only obliged to hand it on in a similar manner to which they receive it, and in fact where it comes down in large quantities in a disorderly manner, they have no alternative but to get rid of it as quickly as possible, and at close intervals.


RANGE OF HILLS
RIVER
Road
Road
SKETCH shewing suitable lay-out to enable storm water to be delivered in a satisfactory manner to road drains
REFERENCE
a. Hillside drains.
b. Ridge Terraces.
c. Road drains.
d. Ridge-Terrace-drains 1in200
e. Old drain which now receives water from road only.
IRRIGATION DIVISION
12.10.36 B.K.H

In cases like this soil conservation of lands below the road is quite impossible, and one has to watch dongas forming at each invert and at each breach in the drains. The person to blame for this state of affairs is the man above the road.

It is high time that the legal aspect of the disposal of the storm water was made clear. I am certain that then it will be found that the roads are more sinned against than sinning.

They are only responsible for the amount of the actual catchment on the road and the water which they divert from its natural valley or direction. Actually road drains are a mixed blessing, as water is concentrated and there is often no alternative but to discharge it where it will do damage. With co-operation a remedy can be found, and there is no reason why road drains then should not be of benefit to the lower lands.

Do not expect the Roads Department to meet you until you are willing to help them, when they will more than meet you.

The attached sketch plan shows a suitable lay-out to enable storm water to be delivered in a satisfactory manner to road drains.

In this sketch the following symbols indicate the various types of drains constructed:—

(*a*) Hillside drains.

(*b*) Ridge terraces.

(*c*) Road drains.

(*d*) Ridge-terrace-drain, 1 in 200.

Four washes through the lower land have been stopped. The middle invert is no longer used, also several smaller ones not shown.

Water is now delivered to two places only. The boundary drain on the left and a drain at the side of a farm road in the centre. This drain has become a donga, but will not give serious trouble as it has reached a rocky bottom.

Many ridge terraces have been omitted in the sketch. Road drains above the road used to choke up with silt every big storm and overflow in many places.

The land below was being seriously eroded, but it was impossible to conserve it until the road drains and inverts had been re-designed. It was impossible to do the work on the road until the land above had been storm-drained and ridge-terraced.

Nearly every farm along a road is faced with similar problems to a greater or lesser degree. Existing culverts and inverts are being rapidly replaced by permanent concrete work. Therefore if a farmer desires to protect lands below the road the land above must be done before the Roads Department put in permanent works.

There are many cases where road inverts every 200 yards are each causing a donga, owing to the lack of protective works above, their number cannot be reduced.

The Roads Department are keen to encourage protective work above their roads. The removal of silt from the roads and repair of ravages caused by choked drains is an expensive item each wet season.

NATURAL PROTECTION FROM SOIL EROSION.

By S. D. Timson, M.C., Assistant Agriculturist.

Foreword.—Nature's own method for the prevention of soil erosion is by the growth of vegetation. The roots of trees, shrubs and grasses hold the soil in situ, whilst the fallen leaves act as an absorbent mulch on the surface, which assists by helping the rain to penetrate the soil surface, and protects the surface soil from the water as it runs off. It must therefore be one of our objects in combating soil erosion, where such a source is practicable, to assist Nature to restore or form this protective covering of vegetation.

At the present moment there is a pressing need for types of plants, which can be planted or sown on the areas where contour ridges spill their burden of water, and on the banks and sides of gullies formed by erosion, which are in process of being reclaimed.

There is not sufficient experience available at present to dogmatise as to the types of plants best suited to the special conditions arising on the sides of gullies, where the sub-soil is completely exposed, and this is a problem of some difficulty owing to the marked infertility of the sub-soil in the red, chocolate, and black loam soil areas; but definite recommendations can be made with regard to grassing the wet vleis, and dry valleys, which are not yet severely eroded, and which are being utilised as the channels to receive the water from contour ridges and storm drains.

Suggestions can also be put forward which, it is hoped, will be helpful in assisting farmers to find types of plants which will grow on the sides of dongas or gullies under reclamation.

PART I.

Protection of Moist Vleis.—The vleis of more or less moisture-retaining soils, both the sandy vleis and the heavy black vleis, which are in danger from erosion owing to their

having been ploughed up or because they have lost all or much of their natural protective covering of grass through excessive grazing, or for some other reason, may be laid down under one of the following grasses :—

Paspalum dilatatum (Common Paspalum).—Where it is desirable to obtain a complete cover as soon as possible this grass is to be recommended, since it is the only type suited to the moist conditions of which seed is commercially available at a reasonable price.

It is a very valuable pasture grass, which will yield grazing most of the year round in frost-free situations, but makes little growth during a cold winter. It is frost sensitive.

The land should be ploughed and worked to a fine tilth during winter or early spring in preparation for sowing the seed after the first soaking rains. It would normally be preferable to delay sowing to enable weeds to be dealt with, but in the special conditions under consideration this would probably allow severe erosion to take place. Where conditions allow an alternative is to prepare the seed-bed in January, and sow in January and early in February.

To ensure success and because this grass yields valuable grazing, which can be turned into cash, it is advisable to apply 150 to 200 lbs. per acre of a suitable complete fertiliser containing about 8 to 10 per cent. of nitrogen.

Still better is a dressing of 3 to 5 tons per acre of manure or compost.

Manure or compost should be ploughed under. The fertiliser may be broadcast prior to sowing and covered with a disc-harrow.

A fine and firm seed-bed is essential to success. The seed, preferably Australian, *should be the best obtainable*, and costs about 60s. per 100 lbs. The germination capacity of paspalum seed is practically nil for recently harvested seed, and a *guarantee should be required from the seller that the seed is at least* 18 *months old from harvesting* to ensure a reasonably good germination within three weeks. In certain cases in this Colony the writer has known germination not to take place until some months ofter sowing. The seed should be

mixed with several times its bulk of dry sifted soil or fine sand, and divided into two halves. One half should be broadcasted in one direction across the field, and the other half at right angles to this so as to ensure an even sowing. The seed should be covered with a brush-harrow or light drag-harrow.

Sowing may be done at any time in December to January, but the latter half of December, after the first flush of weeds has been dealt with, is probably the best time.

Rhodesian Sudan Grass (*Sorghum arundinaceum*).—This grass normally grows on the heavy black vlei soils of the maize belt, and is to be found on many farms in the Mazoe Valley and Lomagundi district, though it is not yet certain whether it would thrive on the wettest portions of such vleis.

Where it will thrive it is very suitable for soil erosion prevention, and may be cut for silage and hay, *but at present it is not certain that it is free from the danger of prussic acid poisoning when grazed*, though all the evidence at present available indicates that it is a safe pasture. It is certainly present in most of the best riverside pastures in the Mazoe Valley. If it proves to be safe pasture in a pure stand it will be particularly valuable, because it gives good grazing from August onwards, and yields a great bulk of grass, which has a high feeding value by analysis.

Seed of this grass is not commercially available, but small free issues sufficing to sow a two-acre seed plot are obtainable from this Department on application to the Agriculturist. It is a free seeder. The instructions for sowing paspalum are applicable to this grass, but a seeding rate of 20 to 25 lbs. per acre should be used, and sowing should be done in spring.

On soil which is fertile and has not been severely eroded it may thrive well enough without applications of fertilisers or manure, but it will naturally benefit from them. It has the particular merit for soil erosion prevention of being a very rapid grower. No information is available regarding its suitability for sowing on sandy wet vleis.

The other grasses which can be recommended for such soils are indigenous and must be propagated by root division, or cuttings. They are as follows:—

Swamp Couch (*Hæmarthria fasciculata*).—This grass thrives on all types of moisture-retaining soils, and is a very rapid grower; it is very palatable to stock, and of good feeding value.

It can be strongly recommended for the protection of vleis as it is very hardy and spreads rapidly by means of robust runners.

It yields valuable grazing throughout the winter and is extremely hardy and thrives even on poor granite vleis.

It must be propagated from roots, and it will succeed best if the roots are planted in a well prepared seed-bed.

Planted at a spacing of 4 feet by 4 feet on fertile soil or as close as 3 feet by 3 feet on less fertile soils its runners will completely cover the ground in the four months of summer, December to March. For the wetter moisture-retaining soils this grass is pre-eminently suitable, and it will also thrive on the drier vlei soils. On the Hillside Experiment Station it has yielded excellent grazing all the year round on a poor granite vlei, without fertiliser or manure, for six years.

Creeping False Paspalum (*Brachiaria dictyoneura*).—This grass is admirably suited for erosion prevention in suitable situations, since it is a rapid grower and forms a tough, dense turf resistant to wash and weed growth. It is also a very valuable pasture grass, and in the pasture grass trials at the Salisbury Experiment Station as a pure stand has yielded an average of 253 grazing days per acre for one ox over a period of four years under dry land conditions.

It thrives both on dry land and on moisture-retaining soils, but swamp couch is preferable on the wettest portions of vleis. On the wet granite sandy vlei at the Hillside Experiment Station it has yielded excellent pasture all the year round for the last six years without fertiliser treatment or manure. A good seed-bed should be prepared in spring as for swamp couch, and it may be planted in December at a spacing of 3 feet by 3 feet with the expectation that its runners will cover the ground during the ensuing summer.

Kikuyu.—Mention may also be made of Kikuyu. This grass is valuable for the purpose under consideration, but it requires good fertile soil and an ample rainfall to thrive.

Where roots are obtainable it should be tried, and in the Eastern Border district and Melsetter it should be of considerable value. Roots may be planted at a spacing of 3 feet by 18 inches, or less, if a quick cover is necessary.

Para Grass (*Panicum barbinode*).—On wet vleis, both heavy and sandy, this grass may find some use for temporary prevention of soil erosion, since it is rapidly propagated from cuttings, which may be simply thrust into the wet soil at an angle and firmed with the foot.

It is not, however, a very permanent grass and will not resist erosion as well as swamp couch and creeping false paspalum, owing to its not forming a dense turf.

Summary of Advice for Moisture-retaining Soils.—To summarise the foregoing advice, *Paspalum dilatatum* offers the best and at present the only weapon for rapidly grassing large areas of moisture-retaining vleis, since it is the only suitable grass of which seed is commercially available. It yields valuable pasture for the production of beef and dairy products when well treated.

Swamp couch and creeping false paspalum will eventually yield a turf which is more resistant to erosion than paspalum, but at present supplies of roots for planting are very limited, and farmers will have to plant nurseries to provide planting material. On most wet vleis these two grasses are to be found in the indigenous cover, and so material for planting nurseries is usually available on the spot, and will shorten the interval necessary for propagation of planting materials.

Seed of Rhodesian Sudan grass is available in limited quantities for sowing seed plots, but experimental plantings should be made to determine to what extent it will thrive on the wettest portions of the heavy black vleis. It can be recommended for sowing on the drier portions of heavy black vleis, but it is not known yet whether it will thrive on poor sandy wet vleis. It is also uncertain whether it is safe from the danger of prussic acid poisoning as pasture. It is well suited, however, for the making of excellent silage, and for making hay it is cut before it commences to flower. Kikuyu is admirable where it will thrive.

PART II.

Protection of Dry Valleys.

Rhodes Grass (*Chloris gayana*).—Where dry well-drained valleys are to be protected from erosion Rhodes grass takes the place of paspalum on wet vlei soils. It is the only suitable grass of which seed is commercially obtainable, and is therefore the only grass which can be used for immediately grassing large areas. It yields valuable crops of fine quality hay and excellent grazing.

The instructions for sowing paspalum apply for establishing Rhodes grass, but greater care must be given to the preparation of a fine firm seed-bed, and the regular application of fertilisers will probably be necessary to ensure a reasonable degree of permanence. It may prove necessary to plough and re-sow the grass after a period of years. It should be sown at the rate of 6 to 10 lbs. per acre, according to the fertility of the soil, and the quality of the seed. The best seed is always cheapest.

Creeping False Paspalum (*Brachiaria dictyoneura*).—This is probably the best grass for protecting dry soils, since it is a rapid grower, spreading by above-ground runners, and forms a very dense tough mat, which resists the entrance of weeds and other grasses, and the eroding action of water. It must, however, be propagated from roots, as it only produces a sparse crop of viable seed. Reference has already been made to this grass earlier in this article.

Woolly Finger Grass.—This valuable pasture grass is also suitable for dry land, but it does not form such a dense mat as creeping false paspalum, nor does it cover the ground so quickly. There are, however, a number of sources of supply in the Colony, and a large quantity of planting material is available at a price of 7s. 6d. to 10s. per bag on rail.

It should be planted in December at a spacing of 3 feet by 18 inches. About 8 bags of roots will plant one acre. It is a very permanent grass, and one very important characteristic is that it commences growth as soon as frost is past, and it remains palatable, and of good feeding value all through the winter, even after being frosted. Indications are that it

will thrive even better on good sandy soils than on the heavier loams. The following record of its propagation on one farm on light sandy soil will indicate how rapidly it and other creeping grasses already mentioned may be propagated.

November, 1927.—"One quarter of a sugar pocket" of roots planted.

February, 1928.—Broken up and transplanted on two acres.

October, 1928.—A further 13 acres planted.

October, 1929.—A further 9 acres planted.

1930.—Sufficient roots available to plant 100 acres of ground.

Vi-Vi (*Leucæna glauca*).—This perennial leguminous shrub should prove valuable for erosion prevention, particuluarly on exhausted or eroded dry land soils, since it can provide its own nitrogen supply, and only phosphate and potash need be supplied. On moderately fertile soils it will require no fertiliser.

It may be planted in continuous contour rows at intervals of 4 to 8 feet according to the severity of the slope, leaving a space of about 6 to 18 inches between "hills" in the rows. A dressing of rock phosphate, or rock phosphate and muriate of potash, will ensure rapid establishment. Six to eight seeds should be sown in each "hill."

If it is planted as hedges on contours, and cut back each year to a height of about 18 inches, the cut branches being placed on the uphill side of the cut stems, the barrier thus formed causes rapid silting, and after a while level terraces are formed.

One particular virtue Vi-Vi possesses for this work is that its tap-root is pushed down into the soil at a remarkable rate. In Java in a well drained soil it made growth of 7 feet 8 inches in six months, when under similar conditions the tap-root of sunnhemp only penerated 9 inches. Although this method of propagation has not yet been tried in this Colony as far as is known, the International Institute of Agriculture, Rome, in a recent publication states that it is easily propagated by cuttings, which should be from branches $\frac{1}{2}$ to $\frac{3}{4}$ inch in diameter.

As a fodder bush it is very valuable, since it has a very high feeding value, the twigs and leaves together containing over 18 per cent. of crude protein according to analysis made by this Department. It is unfortunately immensely palatable to all our wild life, and for that reason is difficult to establish unless it is protected by adequate fencing.

Horses and mules should not be allowed to browse on it, as eaten in large quantities it causes the hair of the mane and tail to fall out. For cattle and goats it is a safe feed, and is utilised as a browsing crop in many countries. It has the very valuable characteristic of remaining green and palatable to stock throughout our winter on dry land.

The seed, of which heavy yields are obtained, has a poor germination, and to increase this it should be thrown into boiling water, which is immediately taken off the fire and allowed to cool. The seed is left to steep in the water for 24 hours and then dried and sown.

The writer considers that if Vi-Vi can be protected from buck and hares it will prove of particular value for preventing soil erosion, particularly on the sides of gullies caused by erosion. One pound of seed contains about 9,500 seeds, and 14 pounds will therefore plant one acre of ground at a spacing of 4 feet by 6 inches, when 6 seeds per "hill" are sown. At 8 feet spacing by 18 inches, and the same seeding rate per "hill," only 2.3 lbs. of seed is required per acre. The seed loses its germinating capacity rapidly after four or five months.

In Mauritius fields of Vi-Vi are largely used for pasturing working oxen, and the seed is also fed to them freely after boiling to soften the hard seed coat. The seeds contain a very high content of crude protein, nearly 30 per cent.

Napier Fodder (*Pennisetum purpureum*) and **M'fufu.**—This tall tufted perennial grass can be usefully employed in preventing soil erosion on dry lands. It can be rapidly propagated from cuttings, which should be taken from mature canes and have at least three nodes. The cuttings may be planted in wet soil at a spacing of 4 feet by 2 feet up to 4 feet by 4 feet at any time after the rains break in spring. The cuttings may be planted slant-wise in the ground with two-

thirds of their length below ground, or they may be buried in shallow trenches so that the cuttings overlap each other. Cuttings should be planted in wet soil. It may also be propagated by root division, and the use of rooted slips is probably the most sure method, since they are very hardy, and will withstand drought better than cuttings.

This grass will provide a greater bulk of useful forage year by year without replanting than any other crop, on fertile soil. It should not be allowed to grow too coarse before cutting or grazing. It should be cut when between 3 to 4 feet high for fodder or silage. It provides particularly valuable grazing in early spring after frosts are past.

M'fufu is a strain of Napier fodder which is finer in growth and has a more open crown. It is rather less hardy and does not produce quite the same bulk of fodder. If Napier fodder is planted rather more widely in the rows than advised above, Kudzu Vine can very usefully be established at the same time between the rows by planting "crowns" every 6 feet. One or two ounces of superphosphate or rock phosphate mixed with the soil in the holes will go far to ensure success. The resulting mixture makes very valuable and nutritious pasture, and a dense defence against washing of the soil.

Common Couch (*Cynodon dactylon*).—This grass is of particular value in certain situations, because it is very hardy and drought resistant, and can be found on every farm in the country, and is well known to most farmers as a very serious weed of arable lands. In its proper place, however, and under proper treatment, it is a valuable pasture grass, particularly for sheep, and in the writer's opinion it has been unjustifiably neglected.

There are many different strains of this grass, which are morphologically identical, but vary considerably in habits of growth and drought resistance.

The tall-growing, vigorous, rapid-spreading strains should be chosen for this purpose, since many of the other strains are very slow in growth. It is one of the few grasses which will grow on sub-soil, though it does not, of course, thrive. On fairly fertile soil the quick-growing strains will cover the ground in one season if planted in December at a spacing of 36 x 18 inches.

It produces practically no viable seed, and so roots or runners must be planted. An Australian strain produces viable seed freely in that country, and under conditions in this country this strain is a very much more rapid grower than most local strains, though not quite so drought-resistant. Seed of this strain is obtainable from Cape Town merchants.

Roots should be collected and planted out in December. This grass is suitable for all dry land soils and for the drier portions of heavy vleis.

Kudzu Vine.—Kudzu Vine is too slow in establishing itself to be of use by itself in situations where rapid erosion is likely to take place. It requires three or more years to cover the ground when planted at the spacing normally used of about 10 feet by 15 feet. The total available supply of crowns in the country would not plant more than a few acres at a spacing which would allow it to cover the ground in, say, 18 months.

It may have a special application for reclamation of dongas, which will be mentioned later, but it is feared that the small available supply of planting material very greatly limits its usefulness. If once established, of course, no type of vegetation could be found more suitable for the purpose, since it covers the ground with a dense mat of runners, and it is of particular value as a stock fodder crop.

Star Grass (*Cynodon plectostachyum*).—This grass should prove very valuable for erosion prevention owing to its vigorous, rapid-spreading habit of growth. Unfortunately there is only a very small quantity of the grass available in this country for planting, though more is obtainable from the Union of South Africa. It is similar to and a close relative of the native couch grass.

Milanje Grass (*Digitaria Milanjiana*).—This very rapidly spreading grass should be valuable for quickly covering the ground, but it forms a very lax open sward, and would therefore not resist heavy erosion so well as some of the grasses already mentioned, such as Creeping False Paspalum. It might serve a very useful purpose, however, in a mixture with other slower-growing creeping grasses, such as that mentioned above, which would later largely take its place.

The uses of Sunnhemp in both Wet and Dry Valleys.—Sunnhemp is a valuable temporary palliative to soil erosion, as a thick stand of this crop will withstand a great deal of wash from storm water if it is sown before the rains arrive. It will not only grow well on the dry valley soils, but also on the wet vleis, both heavy and sandy. It will not grow well, of course, on those portions of a wet vlei which become water-logged immediately after the commencement of the rains. It is being regularly used by many wheat growers on sandy wet vleis as a summer green manure, probably the most unsuitable site for this crop that could be found. However on wet vlei soils it should always be sown early so that it will be germinated and well established as soon as possible, and it should be sown at double normal rates. In particularly unfavourable situations it should be given a dressing of 150 lbs. per acre of superphosphate or, on badly eroded soils, potassic super. Where valleys are to be sown or planted with one of the crops suggested above, and are already serving as conduits for the excess water from the contour ridges or storm drains, it may be very undesirable to plough the soil for the establishing of slow-growing crops at the commencement of the rainy season owing to the danger of severe erosion taking place. Sunnhemp may be sown before the rains in such circumstances, and reaped in January for hay or compost or for putting into cattle kraals for increasing the kraal manure supply. The stubble can then be planted without disturbance, or after one disc-harrowing with those grasses which are propagated from roots.

Contour Belt Grassing after Sunnhemp.—In the case of wet vleis a single light disc-harrowing and one drag-harrowing after broadcasting the fertiliser will usually give a fine enough seed-bed on a sunnhemp stubble for sowing Paspalum, and the stubble should hold the soil in place whilst the grass is establishing itself. The stubble will also enrich the soil materially and assist the growth of the grass.

If it is found that disc-harrowing before sowing causes too much erosion, drag-harrowing only may be substituted, and will usually enable a fair stand of grass to be obtained.

The writer is doubtful whether the same system could be adopted with the sowing of dry valleys with Rhodes grass owing to the small size of the seed, but in such conditions it

should be feasible to sow belts on the contours on the sunnhemp stubble, leaving belts of sunnhemp to mature for seed alternating with the sown areas in order to protect them from wash. This system could also be utilised on wet vleis.

The following year the remaining strips could be sown.

To ensure the sown strips being on the contours they should be marked out with tall poles, which will be visible above the sunnhemp, to facilitate the reaping.

In cases where severe erosion is to be feared after sowing or planting grasses on the reaped strips, the sunnhemp on the unreaped strips could be cut at a height of about 12 to 18 inches above the ground, and laid on the ground between the stubble to form a very effective barrier against the rush of storm water.

Preparing the Soil for the Planting of Protective Crops.—The writer is of the opinion that in most cases it will pay the farmer to always first grow a crop of sunnhemp and reap it for seed, or compost, or kraal manure, after the rains finish, before sowing or planting grasses for protection from soil erosion, where this is possible. The stubble should be left undisturbed until the following spring, when shallow disc-harrowing, followed or not by drag-harrowing, will usually yield an excellent seed-bed, and the sunnhemp stubble will provide sufficient plant food, and particularly nitrogen, to ensure good and rapid growth of the grasses.

Without such prior preparation the writer is doubtful whether in many cases the grasses or other crops can be established in the spring rapidly enough to prevent serious erosion taking place. This would particularly apply where the soil is already partially eroded or has become exhausted by previous cropping.

Where the soil is known to be infertile for any cause, it is considered that a crop of sunnhemp, fertilised with potassic super, should always precede the planting of grasses or other protective crops. Grasses in particular require a readily available source of nitrogen, which is the first plant food to be lost from the soil where erosion takes place. The sunnhemp crop will supply this.

These notes on the use of sunnhemp should be considered in conjunction with those for the establishment of all the crops suggested earlier in this article, particularly those grasses (Rhodes and Paspalum), which are established from seed. In the case of these latter, where there is much slope on the ground, it is thought that the alternate contour belt sowing of these grasses on a sunnhemp stubble would be particularly helpful in establishing them.

Contour Ridging before Establishing Grasses.—On sites which have an appreciable slope and/or above which there is any considerable catchment area it may be necessary to construct low contour ridges before sowing or planting the protective crops. During the interim period when these crops are establishing themselves serious erosion might otherwise take place, which would make it impossible to establish the crops, and the farmer might lose the time and labour he has put into planting them in one night's heavy rain.

Expert advice as to the necessity or otherwise of carrying out this preliminary contour ridging should be sought, and applications for this should be addressed to the Chief Engineer, Department of Agriculture.

Part III.—Reclamation of Dongas and Gullies—will be published at a later date.

Southern Rhodesia Weather Bureau.

DECEMBER, 1936.

Weather of the Month.—An intense high centred over Transvaal and extending well to the north on 1st December resulted in a fine spell. Pressure fell very rapidly, however, and on the 6th pressure conditions were favourable for the onset of rain. Owing to low humidities (dry air having been carried to the north by the high) only showers fell. During the next few days humidity increased and showers became more general, and from 9th to 17th the weather was characterised by thunderstorms. During this period lows were very active over the south coast, and the highs were of little consequence, so that fairly low pressure and weak gradients occurred over Southern Rhodesia. On a few occasions the equatorial low extended into Matabeleland. On the 15th pressure commenced to fall over Madagascar, and remained low during the rest of the month, cyclonic activity being reported in the Mozambique Channel on the 21st and 22nd. Upper winds over Southern Rhodesia were persistently from S.E. during the latter part of the month, and the surface winds mostly from E. or S.E. Weather was mainly fair to fine, but the N.W. equatorial current was traversing Northern Rhodesia and Nyasaland, and affected Southern Rhodesia slightly towards the end of the month. Showers fell, mainly in the north, reaching a maximum on the 31st, on which day some heavy falls were recorded in the north.

Pressure and Temperature.—The monthly mean pressure was generally normal and temperatures were slightly below.

Rainfall.—The rainfall was disappointing, being well below normal in all areas. The average on the whole country was 4.0 inches, or 2 inches below normal.

DECEMBER 1936.

Station.	Pressure Millibars, 8.30 a.m.		Temperature in Stevenson Screen °F.								Rel. Hum.	Dew Point	Cloud Amt.	Precipitation.			Altitude (Feet)
			Absolute.		Mean.												
	Mean.	Normal.	Max.	Min.	Max.	Min.	½ Max. Min.	Normal.	Dry Bulb.	Wet Bulb.	%	F.	0-10	Ins.	Normal	No. of Days	
Angus Ranch... ...	...	...	101	57	87.8	66.2	77.0	78.3	75.7	68.5	70	66	...	3.18	4.57	7	...
Beitbridge...	962.5	...	108	57	93.6	69.8	81.7	...	79.2	67.6	55	62	5.4	0.74	2.45	5	1,500
Bindura...	890.3	...	92	57	82.8	64.0	73.4	...	71.5	64.5	69	61	4.8	5.46	6.78	10	3,700
Bulawayo	868.3	868.2	90	51	81.2	59.0	70.1	71.7	69.8	61.5	62	56	5.6	1.35	5.12	8	4,393
Chipinga	891.2	...	89	50	78.1	60.2	69.1	...	69.6	64.0	75	61	5.3	3.12	7.69	13	3,685
Enkeldoorn...	856.6	...	88	49	79.3	58.5	68.9	70.7	68.8	61.5	67	57	4.6	2.41	6.53	7	4,788
Fort Victoria	894.3	893.9	93	49	81.7	60.1	70.9	73.0	71.6	63.7	67	59	4.9	2.81	5.63	9	3,571
Gwaai Siding	902.4	...	98	49	89.4	61.2	75.3	...	75.1	65.2	60	60	4.4	1.61	5.05	5	3,278
Gwanda...	905.2	...	97	50	86.2	61.8	74.0	...	74.3	64.1	59	59	4.3	3.22	4.60	8	3,233
Gwelo	861.2	...	89	49	79.7	59.1	69.4	71.9	68.5	61.5	68	57	3.8	4.96	6.00	12	4,629
Hartley...	884.1	...	89	51	83.2	60.5	71.8	73.8	72.5	64.3	64	59	4.1	4.84	6.86	11	3,879
Inyanga...	835.8	...	82	48	75.6	54.3	65.0	...	67.6	60.1	65	56	4.3	6.28	7.03	13	5,503
Marandellas	836.5	...	83	48	76.0	57.1	66.5	...	66.3	59.8	69	55	5.0	4.18	7.44	13	5,453
Miami	877.6	...	90	54	81.6	62.1	71.9	...	70.0	63.8	72	61	5.9	4.41	5.92	12	4,090
Mount Darwin ...	906.5	...	93	53	84.5	63.2	73.8	..	73.1	66.5	72	63	5.1	6.62	6.19	9	3,179
Mount Nuza	801.1	...	75	42	64.5	52.2	58.4	...	57.8	55.3	88	54	4.3	7.67	15.55	14	6,668
Mtoko	876.1	...	89	53	80.5	62.1	71.3	...	71.0	64.2	70	61	4.9	4.93	6.58	12	4,141
New Year's Gift...	...	...	97	51	85.8	61.1	73.4	...	74.1	66.1	65	62	...	2.92	5.91	8	2,690
Nuanetsi	960.1	...	107	55	91.9	65.3	78.6	...	78.9	68.3	60	62	5.1	1.73	2.82	6	1,581
Plumtree	863.1	...	92	52	81.4	61.5	71.5	...	72.7	61.8	55	55	3.7	2.97	5.46	9	4,549
Que Que	880.7	...	93	51	84.0	60.5	72.2	...	71.7	63.5	64	59	4.7	3.31	6.20	8	3,999
Rusape	860.9	...	87	47	78.6	58.1	68.3	...	67.1	61.2	72	57	5.0	3.68	7.53	9	4,648
Salisbury	855.1	855.2	88	51	80.9	58.6	69.8	69.6	69.7	61.7	64	57	5.6	2.03	5.86	10	4,831
Shabani...	908.9	...	98	51	83.4	62.5	73.0	...	73.1	64.9	66	61	5.0	4.07	4.80	9	3,131
Sinoia	887.1	...	90	55	84.1	61.9	73.0	...	72.6	65.0	67	61	5.0	4.15	6.89	12	3,795
Sipolilo	884.0	...	89	53	80.5	61.9	71.2	...	72.3	64.6	67	61	5.4	6.25	7.04	10	3,876
Stapleford	841.0	...	80	39	72.8	52.9	62.8	...	64.4	60.1	79	58	5.4	7.22	10.83	14	5,304
Umtali...	891.5	891.6	91	52	83.1	60.7	71.9	71.9	71.6	65.2	73	62	5.8	3.61	5.29	8	3,672
Victoria Falls... ...	910.3	...	97	56	89.5	64.4	77.0	...	75.9	67.2	65	63	3.2	3.70	6.35	7	3,009
Wankie	925.2	...	100	62	91.1	68.6	79.8	...	78.1	69.0	65	65	5.0	5.20	4.77	14	2,567

Rainfall in December, 1936, in Hundredths of an Inch. Telegraphic Reports.

rea	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total	Nc m
1	...	...	...	.	...	...	1	10	12	20	13	11	50	15	19	10	...	2	...	...	...	...	...	...	...	...	...	...	...	24	34	221	4
2	...	...	...	...	...	...	7	17	3	...	2	33	48	104	34	60	14	3	...	...	...	...	...	...	...	...	...	5	...	1	...	331	5
3	1	...	...	...	...	...	17	8	77	5	1	...	7	5	67	81	39	10	...	...	...	...	...	...	...	...	...	27	...	3	27	375	7
4	...	...	...	...	...	...	...	5	21	36	10	61	62	49	79	38	12	15	1	...	...	...	...	...	...	...	...	...	...	3	25	417	6
5	...	2	...	...	2	8	...	29	17	111	3	19	21	37	47	54	1	20	...	...	...	...	...	...	...	...	...	...	...	1	24	396	5
6	...	...	...	...	...	5	9	7	67	29	12	...	30	19	52	64	65	5	...	...	...	...	...	...	1	...	...	...	...	...	38	403	7
7	1	...	...	...	...	17	10	23	53	16	23	8	13	81	83	70	65	1	...	...	...	...	...	...	...	...	...	...	6	5	23	498	6
8	..	...	...	...	...	...	1	20	23	...	18	...	20	60	66	124	104	29	...	...	...	...	...	...	5	...	...	20	7	25	32	554	7
9	...	...	...	...	...	31	3	8	49	...	33	3	9	31	4	108	94	14	...	...	...	...	...	...	4	...	...	15	...	37	110	553	6
10	...	...	...	...	...	44	3	1	...	...	57	3	17	51	70	228	69	16	...	...	...	...	...	...	...	...	...	1	...	...	17	577	6
lean	...	...	...	...	...	10	4	14	28	31	15	16	31	45	43	67	36	10	...	...	...	...	...	...	1	...	...	4	1	11	36	403	60

Southern Rhodesia Veterinary Report.

NOVEMBER, 1936.

No fresh outbreaks of scheduled diseases diagnosed during the month.

MALLEIN TEST.

Twenty-two horses and eight mules.—No reaction.

TUBERCULIN TEST.

Fifteen heifers were tested upon entry with negative results.

Seven cows in a dairy herd were tested by the double intradermal test and gave negative reactions.

IMPORTATIONS.

From Union of South Africa.—18 cows and calves, 12 horses, 8 mules, 754 sheep and 1 pig.

From Bechuanaland Protectorate.—553 sheep.

EXPORTATIONS.

To Union of South Africa.—396 oxen, 12 cows and 6 horses.

To Portuguese East Africa.—23 oxen.

To Nyasaland.—4 horses.

EXPORTATIONS—MISCELLANEOUS.

To United Kingdom in Cold Storage.—Chilled beef quarters, 5,999; frozen boned beef quarters, 5,524; frozen beef quarters, 3,085; kidneys, 3,109 lbs.; tongues, 15,975 lbs.; livers, 18,179 lbs.; hearts, 4,702 lbs.; tails, 3,184 lbs.; skirts, 4,286 lbs.; shanks, 18,208 lbs.

Meat Products.—From Liebig's Factory: Corned beef, 54,968 lbs.; meat extract, 24,016 lbs.; beef powder, 96,340½ lbs.; beef fat, 48,000 lbs.; meat meal, 4,000 lbs.; tallow, 249,546 lbs.; bone meal, 30,000 lbs.

G. C. Hooper Sharpe,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-36.

Monthly Report No. 49, December, 1936.

Winged swarms of the Red Locust (*Nomadacris septemfasciata*, Serv.) have been reported from the following districts during the month, namely, Lomangundi, Darwin, Mtoko, Mrewa, Mazoe, Salisbury, Hartley, Gwelo, Chilimanzi, Victoria, Melsetter, Ndanga, Gwanda, Balalima-Mangwe, Nyamandhlovu, Bulawayo and Matobo.

No particular trend of direction of flight is indicated by the reports, the four points of the compass being almost equally represented.

No egg-laying had been reported to the end of the month.

Damage to young crops occurred in two districts.

Birds are stated to have been following the swarms in large numbers in several districts. No disease or parasitic outbreak amongst the locusts has been recorded.

Many of the swarms have been of large dimensions, and whilst the intensity of the present swarm cycle of this species has diminished in so far as it affects Southern Rhodesia, the possibility of recrudescence is not to be ignored.

One successful breeding season would lead to a manifold increase in numbers, and in the present apparent absence of disease amongst the insects, must be regarded as a distinct possibility during the present year.

RUPERT W. JACK,
Chief Entomologist.

THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.
(Assisted by the Staff of the Agricultural Department).

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Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Grassland as a Rotation for Cotton.—In advocating that the farmers should grow cotton in rotation with grassland, Mr. W. G. Wells, in the *Queensland Agricultural Journal*, states that where such a system is practised the crop is grown on soil which has a suitable carbon-nitrogen ratio for the production of good yields of cotton, and a physical condition that allows of a high degree of efficiency of penetration of even storm rains being obtained. In addition to these factors, the grassland rotation tends to suppress weed growth. The net result is an increased yield of lint per acre, an improvement of quality, and a marked reduction in cost of production, both through increased yield and lessened cultivation costs.

Boron as an Essential Element in the Healthy Growth of Citrus.—Soil applications of borax have proved extremely effective in controlling a malady of long standing in mature citrus trees on the Mazoe Citrus Estate in Southern Rhodesia, known locally as the "hard fruit" problem.

The malady is slowly progressive and is characterised in its extreme form by marked defoliation, "dieback," and the development of small leaves with diminutive indentations on the ventral surface. In this stage of the disease the bulk of the crop is shed between October and December, suggesting a state of internal or physiological drought within the tree itself. Fruits remaining on the trees are worthless for consumption owing to mis-shapen appearance and arrested development of internal tissues. Gum pockets, or corky patches are invariably present in the fruit, the absence of juice in which gives rise to the local name of ""hard fruit" for the disturbance.

Conditions aggravating the development of the disease are high temperatures, low humidity and a soil status favouring rapid drainage.

The loss from "hard fruit" at Mazoe is estimated to run into several thousands of cases annually.

Soil applications of borax in small quantities have been found to bring about a marked recovery in Valencia Late trees in all stages of the malady.

This discovery has been made by Dr. A. A. Morris, research chemist to the B.S.A. Company's Citrus Experimental Station at Mazoe, and is the first instance recorded from the field of the essential nature of boron in the healthy development of citrus.

Haas and Klotz, of the California Agricultural Experiment Station, were able to demonstrate a boron deficiency in young citrus trees under carefully controlled conditions in sand cultures, but the symptoms show little similarity to those found at Mazoe under field conditions.

Soil Erosion in U.S.A.—That the present crisis in American agriculture has physical as well as economic aspects is now a familiar fact. Recent dust storms, after last year's drought, apprised the whole country of it, and drew attention forcibly to the problem of soil erosion. Formerly we were only dimly aware of the truth that the soil is not an inexhaustible, abundant, and immutable factor in our farm economy and that land exploitation finally must give place to land conservation. Not until the frontier had dissolved into the Pacific did we realise that the opportunity to abandon worn-out land for new was gone. Up to that time we had been embued with a pioneer psychology that was indifferent to the soil lessons of history and to contemporary practice in other countries.

A physical crisis in agriculture, coming on top of an economic crisis, shook us out of this lethargy, warned us dramatically that our ratio of population to productive land resources is going up, that practically all the better lands have been occupied for agriculture, that much formerly fertile land has been ruined or greatly impoverished, and that considerably more land will go the same way unless we take steps to save it. It may be useful, before describing the soil conservation work now in progress, to indicate why it is necessary. This takes our story back to the Indians, who did little to change the virgin character of the land surface and its vegetation. In their day rivers draining the densely forested areas generally ran clear except in high flood. Vegetation ranging from grasses to dense forests covered the larger areas of the country, protected the land surface from rain-wash, and favoured the absorption of rain and melting snow. There was little surface washing. Such erosion as did occur was of a geological or normal character and did not exceed the rate of soil formation. Then the white man came with axe and plough and livestock. Advancing rapidly, farmers, lumbermen, and stockmen pushed the frontier further and further westward, cleared the land of forests, turned the prairie sod, and overstocked the range. They bared millions of acres to the wash and sweep of rain and wind, and soils which had been thoroughly protected for thousands of years began to erode.

It is estimated that erosion costs the United States approximately 400,000,000 dollars annually in soil deprecia-

tion and reduced yields. This figure does not include the damage to navigation, water power, irrigation, and water supply developments.—(U.S. Year Book, 1936.)

Enzymes.—Much remains to be learned about enzymes—the ferments produced by the vital activities of living cells. Study of their action as it appears in the cellular processes of respiration and metabolism, oxidation and hydrolysis is essential to the solution of many agricultural and industrial problems. Among these problems are the utilisation of enzymes in food, beverage, chemical, and other industries; the destruction of the enzymes that cause agricultural products to spoil, the function of enzymes in the curing of hay and the fermenting of silage; the employment of enzymes in the analysis of agricultural products; and the preparation of enzymes for medical use. The generally important result to be expected from enzyme chemistry is the explanation of many physiological processes, as mysterious now as was digestion—an enzyme process—a hundred years ago. Very lately the mechanisms of fermentation and respiration have been partly worked out this way.

Research in the United States Department of Agriculture has dealt already with some aspects of the rôle of enzymes as, for example, the deterioration of stored eggs and the fermenting of dough for breadmaking. Other problems in which enzymes seem to play a significant part have been little studied. What substances in sweet clover inhibit the blood-clotting mechanism and cause animals to become bleeders when fed sweet clover hay? What relation, if any, have enzymic processes to the premature sterility of livestock? What are the enzymic reactions that constitute the processes of ripening in fruits, in grains, and in meats? These are typical questions about enzymes, the answers to which would be tremendously useful, but which cannot be answered without more fundamental research.—(U.S. Year Book, 1936.)

Altitude and Boiling Point.—The following particulars are of interest when considering sterilising canned fruit, etc., by boiling. This does not apply, of course, to sterilising under pressure.

Altitude.	Water boils at	Additional time.
512	211	2 minutes.
1,025	210	4 ,,
1,539	209	6 ,,
2,063	208	8 ,,
2,598	207	10 ,,
3,115	206	12 ,,
3,642	205	14 ,,
4,169	204	16 ,,
4,697	203	18 ,,
5,225	202	20 ,,

Vi-Vi (*Leucæna glauca*).—In August, 1934, an article was published in this journal under the heading "A Promising Fodder Plant." This dealt with *Leucæna glauca*, commonly known in this country as Vi-Vi. It was pointed out that according to an analysis made by the Chemistry Branch of the stems, leaves and pods the plant was very rich in protein (21.4 per cent.) and that it should prove to be a very valuable fodder crop, particularly during the dry part of the year, as it is an evergreen.

In February, 1936, however, it was considered desirable to issue a warning in view of particulars published in *Herbage Abstracts*. From this source it was gathered that if fed in any quantity it would cause horses and pigs to lose their hair, and it was further suggested that it caused sterility in dairy cows and in sows.

As the plant was originally obtained from the Queensland Department of Agriculture enquiries were made in that quarter, and it was ascertained that although it had been fed for many years no damage to stock had been observed.

In a recent publication from the International Institute of Agriculture, Rome, reference is made to the use of this plant in a large number of countries. In the introductory paragraphs several points of interest are recorded. Thus it is stated that when eaten by horses or mules the animals tend to lose the hair of the manes and tails, but that it is innocuous to cattle and goats. Large quantities of seeds are produced, but they soon lose their germinating power, and after four or five months only about 50 per cent. grow. In a number of

countries it is used as a shade for coffee, and in others owing to its high nitrogen content it is used as a green manure, or for making compost. In a number of countries mentioned by the International Institute no reference is made to the use of the plant for fodder, and during a recent visit of the Chief Agricultural Officer of the Belgian Congo to this Colony he was very surprised to hear that cattle would eat the plant, as he said that although it was grown as a shade for coffee in his territory he had never heard of it being eaten by cattle. In the report for Indo-China it is stated that it is grown extensively for shade and it is recognised as an excellent fodder plant. In the Dutch East Indies it is used as a shade for coffee and as a living support in the vanilla plantations. It is also extensively utilised as a green manure for rubber, tea, coffee and cocoanut. Monkeys are said to cause great damage owing to their fondness for the young pods. In Nyasaland it is recorded as not being too successful as a shade for coffee, but that it has been used as fodder. In Mauritius *Leucæna glauca* is particularly common. Its date of introduction is unknown, but it is reported that leaves and seeds are regarded as an excellent fodder for cattle, but that the seed should be first boiled or ground owing to the hard seed coat. It is recorded that it is indigenous to New Caledonia, where it is much appreciated as a fodder crop.

It will be seen from the numerous records that it is not generally looked upon as a crop dangerous to cattle. It is known, however, that plants vary in their production of poisonous substances on different soils and in places with different climatic conditions.

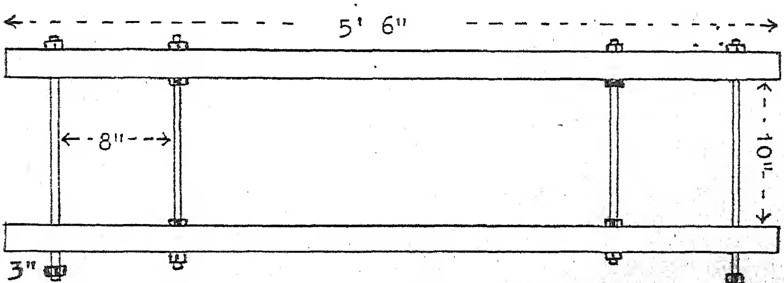
It has been found that, unlike the Belgian Congo, the livestock in this country are particularly fond of this plant and will browse it during the winter, even devouring the thick stems. It should be perfectly safe to allow bullocks and young cattle to take advantage of the protein supplied by this plant; but care should be taken in the case of dairy herds until more information is available. This is suggested not only on account of the possibility of the plant causing sterility, but because of one report which has been received to the effect that where cows were allowed free access to the plant the milk and cream had a definite taint.

BREAKING IN YOUNG OXEN TO THE YOKE.

By J. B. West, Dromoland, P/B Lonely Mine.

There is no doubt that many farmers and transport riders would like to know of an easy and humane method of breaking in young oxen to the yoke. This operation is generally left to the native driver, and most farmers are unaware of the excessive cruelty these natives cause while doing so.

The method I am about to explain is very simple to make and the two oxen, without any supervision, train themselves.



First procure two lengths of 2 inch or $2\frac{1}{2}$ inch piping, 5 feet 6 inch in length and drill holes at the distances marked on diagram to take $\frac{3}{4}$ inch or $\frac{7}{8}$ inch round iron for making the bolts. The two centre bolts are a fixture and must have about 4 inches of thread cut at each end to go right through the piping and nuts screwed tight in order to obtain a rigid double yoke.

The idea of the double yoke is that the oxen cannot get themselves loose while attached to them.

The two outside bolts are simply dropped right through the two yokes when placed on the oxen.

When the outside bolts, which should be about 3 inches longer than the centre bolts, are in position a loosely fitting nut can be screwed on by hand to prevent them from jumping out when the oxen are lying down.

After putting on the double yoke do not take it off. Let the oxen graze with it on and also leave it when kraaling the oxen at night. You will notice that it is not cumbercome to them.

It about a week's time the oxen will have become so used to carrying the yoke that no difficulty will be experienced when placing them in the span with the older trek oxen, preferably in the centre of the span.

The diagram will explain the measurements suitable for oxen of 2 to 3 years old.

My reason for suggesting piping instead of round poles it that it is light and practically indestructible and will last for years.

These yokes can also be used for haulage by passing the chain or trek tow between the two yokes, but with heavy loads the 2 inch piping is liable to bend, so I do not recommend them for trek purposes but only for breaking in young oxen.

SOIL CONSERVATION.

CHAPTER III.

EROSION ON CULTIVATED LAND.

Types of Erosion.—Erosion on cultivated land takes place in two main forms: (1) sheet erosion, and (2) gully erosion. Sheet erosion, as its name indicates, consists of a skimming off of the surface, a fraction of an inch at a time, and is therefore often invisible, a fact which deceives many farmers when they state that they "lose nothing at all by erosion." Actually, sheet erosion occurs on practically every cultivated land, even though apparently flat, and is all the more dangerous for being invisible, so that the unhappy owner is made aware of his loss only by a gradual decline of crop yields. An inch of rain will carry off a ton or more of soil per acre, and this silt will obviously contain a larger amount of the lighter elements, such as humus and soluble plant food, than a ton of soil in its original position. For this reason the soil deteriorates in texture as well as in depth and fertility, and requires an excessive amount of green-manuring and fertilising to make good its losses.

Gully erosion is more spectacular and causes very heavy local losses through the spread of lateral branches. The area affected widens annually in this way, and lengthens as the head cuts back to the land above, while the gully itself becomes deeper and wider until it is impossible for a plough to cross. Many broad lands have been cut up and spoilt in this way, and if neglected too long the gullies may be beyond reclamation, although they may be controlled as described in Chapter II. If taken in time, however, they may be blocked and crossed by contour ridges, as shown in fig. 20. The longer a badly-gullied land is neglected, the more expensive it becomes to protect. Gully erosion will frequently develop from sheet erosion, through concentrated flow in any depression or channel, natural or artificial, and the beginning of this process is shown in fig. 12.

Factors which Influence Erosion.—The rate of erosion is dependent on several factors, some of which are natural, and therefore largely uncontrollable, while others are artificial, and therefore, controllable, but there is often no hard and fast distinction, so that one farm which has natural disadvantages may be maintained in good heart by intelligent farming practice while another, which is well favoured, may be ruined by mistaken methods.

Natural factors :—

(1) Rainfall intensity.
(2) Slope and contour of land.
(3) Character of soil (chemical composition, texture, permeability, etc.).

Artificial factors :—

(1) Methods of working (ploughing, harrowing, planting, etc.).
(2) Crops and rotation.
(3) Humus content (green-manuring, etc.).
(4) Selection and size of land.

Rainfall Intensity.—In sub-tropical countries, such as Southern Rhodesia, the rainfall tends to become erratic and violent, which explains why erosion is so serious in this country and practically unknown in temperate climates such as in England. If this is true of the country as a whole, it is even more pronounced in the case of a small area, such as a cultivated land, which is subject to purely local storms of very severe intensity. A rainfall of 3 inches in an hour must be regarded as of common, almost annual, occurrence, and storms reaching a rate of 6 to 8 inches per hour have been recorded. Every increase in the amount and intensity of rainfall causes a larger increase in the amount of run-off. An increased volume of run-off means an increased velocity. If the velocity is doubled, the capacity of the water to transport soil is multiplied 64 times.

Rainfall intensity is beyond human control, but these facts illustrate the necessity not only of protecting cultivated land but also of making the protective works amply strong to withstand our severe conditions.

Slope and Contour of Land.—It is a matter of observation that steep lands will erode more rapidly and severely than lands of gentle slope. The contour is also of importance, since a steep land containing depressions will erode more rapidly than one of even slope. These statements sound sufficiently obvious, but should be remembered before opening new lands on steep slopes. In general it may be said that no land steeper than 1 in 15 should be planted to field crops.

Character of Soil.—Soils vary greatly in their resistance to erosion. To a large degree this is due to differences in permeability, since a tight clay soil, or one with an impervious sub-soil, quickly becomes water-logged, and the subsequent rainfall, being unable to penetrate, produces a heavy run-off. This factor is therefore a direct cause of erosion. It is not confined to heavy clay soils, and it is quite common on certain types of sand veld, which appear absorptive, but are shallow and have a dense clay sub-soil. Impervious soils and sub-soils therefore produce high rates of run-off, especially if puddled through being worked when wet, and require contour ridges at closer intervals than normal.

Soils and original vegetation also differ through a natural adaptation by Nature to climate, and for this reason soils in very wet zones have more resistance to erosion, often because of a higher humus content, than those in arid territories.

The actual "erodibility" of a soil depends on hidden characteristics which can only be gauged by physico-chemical analysis, and for that reason cannot be dealt with in a general discussion.

Suffice it to say that the character of a soil will deteriorate seriously under the action of erosion and bad farming, and the loss of humus and the lighter top soil will render a land, originally friable, liable to "pack" and water-log and plough up into great clods.

Methods of Working.—Correct cultural methods, from the point of view of erosion control, should be aimed at keeping the soil in good condition and encouraging rainfall to penetrate *where it falls.*

An elementary example of what is to be avoided, but one that is still too commonly seen, is the practice of ploughing and planting downhill. Every furrow down the slope is a potential gully. There are lands which have a series of straight parallel gullies every 30 to 40 yards, which are due to no other cause, and are too big to be crossed by implements. When once a land has started to erode in this way the pace rapidly accelerates, and the land becomes poor and unworkable. Contour ridges on a land so cut through with gullies need to be much closer together than on uneroded lands, as the old washes silt up and cause the ridges to break, and are also more expensive owing to the amount of building up required at each crossing. By ploughing and planting on the contour every crop-line acts as a miniature contour ridge, and gives the rain a chance to soak in. Deep ploughing is also beneficial, as it provides a greater depth of loose, and therefore absorptive, soil. Every drop of water absorbed decreases the amount of erosion and stands the crop in good stead during a drought, and in a wet spell reduces the tendency to waterlog.

For the same reason every effort should be made to avoid packing and puddling the soil, especially if of a heavy type. Many farmers cease cleaning and allow weeds to grow when mealies are 3 to 4 feet high, with the idea of preventing erosion, but they forget that the greatest damage is done before the mealies or weeds are high enough to form a dense cover. Moreover, for this or other reasons the land will require repeated harrowings and cultivations the following year, which pack the soil and lead to the formation of a smooth surface crust that is not absorptive and causes further erosion. The excessive harrowing rendered necessary increases erosion and run-off, reduces absorption, and later makes ploughing difficult, and results in great clods which will require soaking rains and further excessive harrowings to break them later. Not only does all this add to the expense of farming, but extra hoeing is required to keep down the weeds which have seeded. Inter-planting with a close-growing cover-crop has all the benefits and none of the objections, and should be practised instead.

The soil should never be worked when wet, as this leads to puddling, and by packing the particles of soil closely together the land becomes impervious, which may take years to remedy.

Crops and Rotation.—Erosion is most severe with a clean-tilled crop, that is with plants widely spaced and with bare ground between, such as maize, cotton, tobacco, sunflowers, etc. Losses of water and soil are greater with crops of this sort than with a low or close-growing cover-crop. For this reason, continuous maize is to be deprecated, and a proper rotation preferred. A season under sunnhemp saves the soil as well as enriches it. The rotation of grasses with tobacco is dealt with later.

Humus Control.—One of the chief factors which reduce run-off and erosion and increase absorption is the amount of humus and fibre present in the soil. When these are completely lacking, erosion can be controlled only by very closely spaced contour ridges. A soil in good heart and containing plenty of humus is easier to work, it absorbs more water and the surface does not pack.

Selection and Size of Land.—There are two situations which should be avoided. One is the middle of a vlei, and the other is a steep hillside. The cultivation of vleis is a great temptation, as the land is open and requires no stumping, but the practice, which was common on many of the older farms, is a disastrous one and has led to the formation of awe-inspiring gullies. The middle of a vlei is the natural water-course, and should always be left as a strip of untouched vegetation, which should be added to by planting other grasses if necessary, and treated as a paddock if suitable, but on no account should it be ploughed. In a vlei that has already eroded, the gully should receive treatment and a strip of 10 to 20 yards on each side should be left unploughed or planted to grass.

Vleis are the natural grazing areas because they retain moisture longest, and it is better to use them for this purpose and plant grasses of good feeding value rather than to put them under cultivation and expose them to the certainty of erosion which will quickly ruin them and make them not

only unsuitable for any useful purpose but will also drain moisture and soil from the rest of the farm. Most crops will be found to do better where the timber was heaviest, and although the initial expense of stumping is greater these areas are easily protected and can remain permanently under cultivation.

Ultra-steep lands should also be avoided. Erosion is so rapid on steep slopes that these lands are very quickly ruined and are expensive and difficult to protect. It is a short-sighted policy to stump a land in the hope that two or three years of cropping will pay for it, because such a land is expensive to work and the crop (and the land) may be ruined in the first year by a sharp storm. Far better to contour ridge it as soon as it is stumped, and put it down to a plantation, orchard or permanent pasture. If initial protection is neglected the paddock will be useless for mowing purposes, because of the numerous small gullies formed before the grass got a hold.

Steep hillsides and the bottoms of vleis are uneconomical for cultivation, because the cost of working and protection is far too high in proportion to the yield of crops, and before long there is nothing left but a mass of gullies or a deep donga which are eye-sores that lower the value of a farm and are sources of difficulty and loss.

A further point in connection with the size of land is that lands in very large blocks will suffer from erosion, even if almost flat, merely because of the excessive volume of water collected on them. For tobacco, particularly, it pays to open a number of smaller blocks of land separated by natural bush or plantations. These small lands are easier to protect from erosion, better sheltered from wind, and reduce the risk of total loss from disease or hail.

Summary.—Much can be done to prevent erosion, in spite of unfavourable natural conditions, by recognised good farming practices, but excess water must be controlled by drains and ridges, and even when the land is completely protected these good farming practices are still most necessary. Conservation measures and good farming should go hand in hand. Much fertiliser is wasted on eroding lands. Contour ridges conserve plant food and moisture but they do not manufacture them.

FIG. 12

SHEET-EROSION ON CULTIVATED LAND

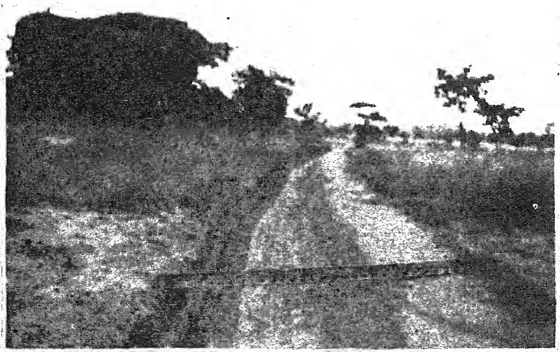
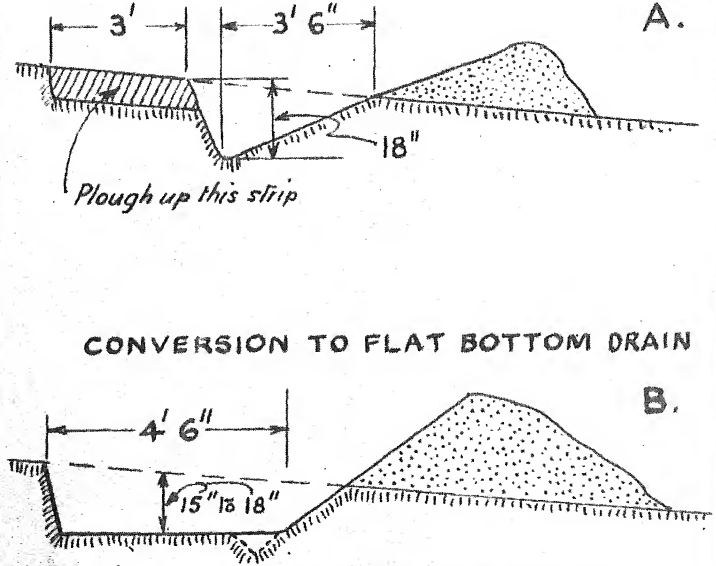


FIG. 13

STORM DRAIN MADE BY DITCHER

FIG. 14.

FLAT BOTTOM DRAIN MADE BY DITCHER



PROTECTIVE WORKS.

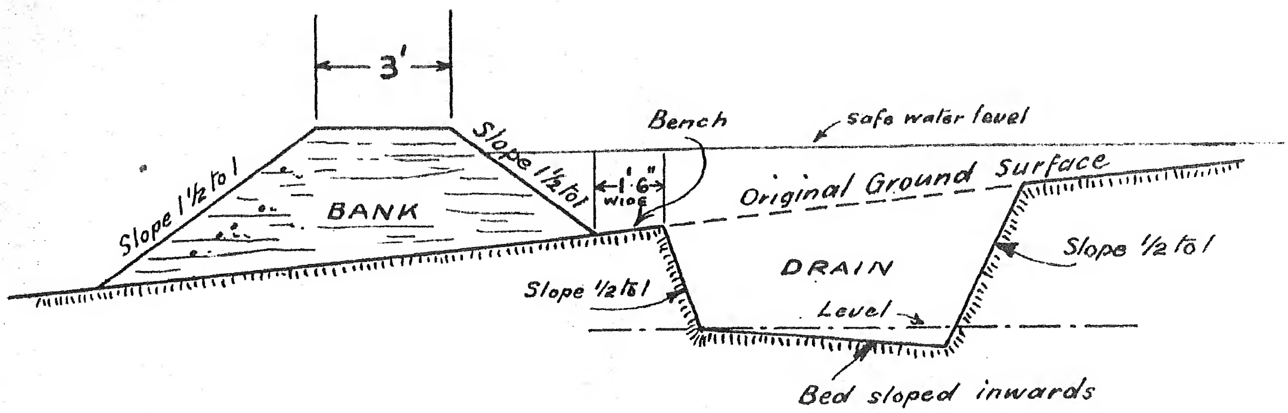
Storm Drains.—Before measures can be adopted to prevent erosion of cultivated lands by the water falling on the lands themselves, steps must be taken to deal with the storm-water from outside areas and prevent its reaching the lands. The only effective method of doing this is by the construction of adequate drains at the head and vulnerable sides of the lands. Full emphasis should be placed on the word "adequate," because it is the common fault to make drains too small, and a drain that is too small will overflow or burst in a heavy storm, with disastrous consequences to the crops and contour ridges in the lands below. For this reason it is most important that drains should be made at least of the full dimensions shown in the table below, even though to the uninitiated they may appear unnecessarily large.

Grades and Sizes of Drains.—For reasons of economy, it is necessary for a drain to be as steep as the formation will stand, but this is easily overdone, and may lead to the formation of dangerous and costly gullies and to the depositing of silt and gravel in undesirable places. For general conditions and in formations of average toughness a gradient of 1 in 200 will be suitable. In very hard and stony ground a gradient of 1 in 100 is permissible.

It is frequently necessary to carry a drain down a steep slope for a portion of the way. Several methods of protection may be adopted. If the formation is soft, it will be necessary to instal "bolsters" or other checks (see "Gully Erosion," Chapter II.) at close intervals in order to flatten the gradient. In other situations it may be possible to lead the drain to the top or side of a rocky slope and allow it to spill out. At the foot of the slope a "trap drain" (a section of level drain sufficiently long to intercept the whole flow) should be dug to collect debris and silt which might choke the next section of storm-drain. The next section of drain should overlap the trap drain to collect the overflow. The system is shown in fig. 16.

Where the catchment served by a drain is steep and hilly, particular care should be taken that the drain is of sufficient size. The sizes shown in the following table are calculated for

FIG. 15.



CROSS SECTION OF A TYPICAL STORM DRAIN

very ordinary conditions, namely, for 2 inches of rain in $1\frac{1}{2}$ hours with a moderate rate of run-off, so that it must be emphasised that these dimensions are *not* on the large side, and for burnt-out or trampled catchments or under severe conditions of any kind they should be increased.

Table of Dimensions of Storm-drains.

Gradient.	Total area of catchment. Acres.	Square Miles.	Bed Width. ft. in.	Top Width. ft. in.	Minimum Depth. ft. in.
1 in 200 ...	80	$\frac{1}{8}$	4 0	5 5	1 5
	160	$\frac{1}{4}$	7 0	8 5	1 5
	320	$\frac{1}{2}$	9 0	10 10	1 10
	640	1	15 0	17 0	2 0
	960	$1\frac{1}{2}$	20 0	22 3	2 3
1 in 100 ...	80	$\frac{1}{8}$	4 0	5 2	1 2
	160	$\frac{1}{4}$	7 0	8 2	1 2
	320	$\frac{1}{2}$	9 0	10 4	1 4

The drains have been designed to permit of a full flood rising partly up the spoil bank. This has been done to reduce the size of excavation and to make full use of the bank. For this reason it is *highly important* that the bank should be constructed and *maintained* in a well-consolidated and protected condition. A useful practice, which adds considerably to the carrying capacity of the drain without extra expense, is to leave a clear space between the bank and the edge of the drain. This is shown in fig. 15. When digging a drain on a side-long slope, it is important to cant the bed of the drain *towards* the hill and away from the bank, as shown in fig. 15. This will keep the main force of the stream away from the bank, which is the weakest point, and localise any scouring that may occur at the place best fitted to stand it.

Special precautions should be taken where drains are required to cross or pick up a gully leading down from hills. Such points are dangerous owing to the rush of water and the sudden deposit of silt which may choke the drain. It is frequently advisable to build a check across the gully above

the drain, and these checks may be of earth or boulders, etc., with an outlet drain to lead the water at an easy angle to the main drain below.

Natural Outlets.—To reduce the size of drains and the strain upon them, they should be led to a natural outlet as soon as possible. These outlets should, however, be carefully chosen to ensure that they are capable of carrying the water without setting up erosion, and in particular channels passing through cultivated lands should be as few as possible. Skill and experience in laying out drains will sometimes achieve the seemingly impossible, and for this reason it is important to obtain expert advice in advance, before digging drains which may do damage and handicap the general scheme of protective works on the lands below or on other parts of the farm.

Construction.—In easy going a great deal of hand labour may be saved by stumping along the line of the drain and using the plough to break up the soil for a sufficient width. It is appropriate here to point out that a broad, comparatively shallow, drain is not only cheaper but is also less liable to scour than a deep narrow drain. After ploughing, the soil may be thrown out by hand or pushed up by means of a ditcher. Figs. 13 and 14 illustrate a drain made with a ditcher and show how a sufficient width can be obtained without excessive depth.

Where hand labour is necessary, the ideal system is "piece-work." The following table shows a reasonable "task" for average conditions, but the figures must be decreased, say, 25 per cent., for rubble or gravel, and can be increased when the soil is soft.

Size of drain.	Length excavated per boy per day.	Volume excavated per boy per day.
4ft. 9in. x 1ft. 5in.	16 feet	108 cubic feet.
7ft. 9in. x 1ft. 5in.	8ft. 6in.	95 ,, ,,
9ft. 8in. x 1ft. 10in.	4ft. 6in.	81 ,, ,,
16ft. 0in. x 2ft. 0in.	2ft. 6in.	81 ,, ,,
21ft. 2in. x 2ft. 3in.	1ft. 6in.	68 ,, ,,

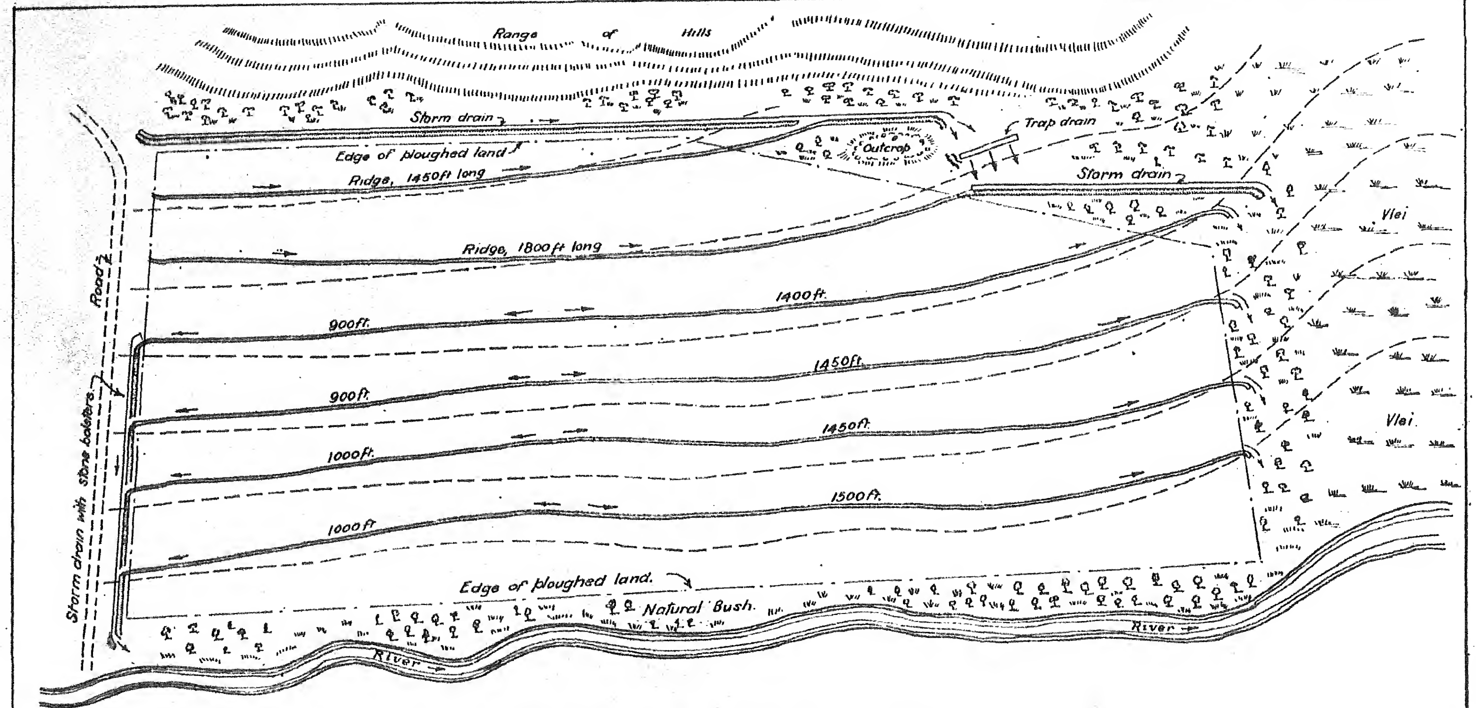
The dimensions of the above drains correspond to those given for a gradient of 1 in 200 in the preceding table.

CONTOUR RIDGES.

Objects and Functions.—Contour ridges are known by many names, contour drains, contour banks, Mangum terraces (after the name of their American originator) and ridge terraces. Any reference to "drains," however, is misleading, because the correct type of construction consists primarily of a broad ridge, and a defined channel is not required. Ridges consist of long, low, broad banks of earth running almost on the level across the slope of the land. A typical system of ridges and storm-drains is shown in fig. 16.

As previously stated, the greater the volume of storm water flowing over a given land the greater the erosion. By constructing contour ridges the land is divided into long narrow strips, and the total amount of storm-water is therefore divided into small volumes which are more easily controlled. Moreover, as the water has but a short distance to run between one ridge and the next, it has more chance of soaking in and less chance of picking up soil. Such little soil as is carried by this water is mostly deposited when it is checked by the ridge, and a very small fraction is lost. Formerly it was considered that one of the most desirable objects of contour ridges was to silt up the ridges, and so actually form terraces, but modern practice is tending to the view that the primary object of ridges is to prevent or greatly reduce any movement of soil down the slope, and the silting-up of ridges is a secondary consideration. Excessive silting generally shows that the ridges have been too widely spaced.

When a land has been ridged, it becomes compulsory to plough on the contour, and it is in this indirect way that the most important object of ridging is achieved. When ridges on gentle slopes are originally laid out with the intention of occasionally working over them, it is still advisable to work on the contour as much as possible. By proper cultural methods, which are described later, it is possible to induce a very large proportion of the rainfall to penetrate *where it falls*, which is the ideal to be aimed at. It is impossible, however, to absorb all the water from a severe storm, and contour ridges are designed to handle the water that reaches



Typical system of Contour ridges & Storm drains on 50 acre land.

(Average slope of land 1 in 30. Ridges approximately 50 yds apart.)

FIG [illegible]

them, hold up and absorb as much water and silt as possible while flowing along the ridge, and finally discharge the surplus.

Lands Requiring Ridging.—Formerly it was considered that only lands steeper than 1 in 40 should be ridged, but experience goes to prove that in many cases lands which are considerably flatter than that (almost level, to the eye) will require ridging, especially if they are of large extent. This is an important factor, owing to the volume of water which collects and runs off a large land. Erosion may not be visible, but sheet washing can remove valuable plant-food unseen, and it is not good economy to put money into green-cropping, manuring and fertilising, and allow it to be stealthily removed.

Length of Ridges.—It has been found by experience that, generally speaking, a ridge should not exceed 500 to 600 yards in length. If it is possible to discharge at both ends, a total distance of 1,000 to 1,200 yards may be covered. Very long ridges, besides being dangerous, are less efficient, as the large volume of water moves too rapidly. With the adoption of a variable gradient, which is discussed later, it is possible to increase the length slightly, but only where unavoidable.

Spacing of Ridges.—Ridges are spaced by measuring the vertical "drop," or difference of level between them. The spacing may vary from a minimum of 3 or 4 feet to a maximum of about 7 feet, and in arriving at the most suitable spacing several factors must be taken into consideration.

In the early days farmers greatly objected to closely-spaced ridges, not realising that they need not waste land nor that the difficulty of working was more than balanced by the benefits gained. The principle of maximum penetration was also neglected. In many instances farmers asked for ridges at wide intervals, and suggested that they would have intermediate ridges later, but this has usually been neglected. In all such cases farmers are advised to have the intermediate ridges put in without delay. With the ultra-wide spacing silting is apt to be excessive, maintenance is expensive, and there is a constant danger of breaching.

The spacing of ridges should be decided by a consideration of a number of factors. On "flat" lands a smaller vertical interval should be allowed, so that the maximum distance between ridges should not normally exceed 70 yards. If too large an area is left between the ridges, the volume of water collected will cause sheet or gully erosion and rapidly silt up the ridges. On steeper lands a bigger drop may be allowed between ridges. In the past a drop of 7 ft. 6 in. has been generally adopted, but it is felt advisable to reduce this to about 6 feet for average slopes and good soil conditions. With this drop, and a land slope of 1 in 25, the distance between ridges will be 50 yards. As a general rule, the area between ridges should not exceed about 7 acres.

The correct spacing will also be affected by the degree of erosion and the way in which the land has been farmed. A land badly cut by gullies and wash-outs, deficient in humus, generally in poor heart, shallow-ploughed and with a marked plough-pan will require ridges twice as close together as one that has been correctly farmed. For this reason it is wise to protect the land as early as possible.

Impervious soils, or soils which may be sandy at the surface but have an impervious sub-soil, require ridges at closer spacing than absorptive soils, for the reason that they produce a heavy run-off.

Gradients of Ridges.—Ridges are laid out on a slight gradient so that the flow will be slow enough to allow the deposit of silt in suspension and the absorption of a part of the flow, and yet remove surplus water.

In areas of low rainfall, where conservation of water is as important as conservation of soil, a very flat gradient can be safely used, which will permit of the absorption of almost all the rainfall. Conversely, lands liable to water-logging will require a relatively steep gradient. Slightly steeper gradients than normal are required on steep land and for certain crops, such as tobacco, which require good drainage.

The gradient normally used in the past, and still regarded as the most suitable for average conditions, is at the rate of 1 in 400, but modifications are required for special conditions, and an important innovation is the "variable gradient."

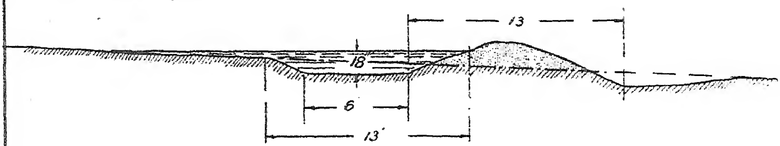
It will be readily seen that there is really no need for a contour ridge to be as big at the "upper" end as at the discharge end, but it is more convenient to make it the same size throughout. The excess size at the "upper" end therefore makes it safe to use a flatter gradient for this portion of the ridge, as the volume of water there is relatively small. This practice has several important advantages. The slower velocity of flow increases silting and absorption of water, and tends to hold back the water until the main volume of water further along has been discharged. This makes a variably-graded ridge safer in a short heavy storm. Strikingly improved results have been obtained with this type of ridge in America.

The following table shows the gradients provisionally recommended for use in this Colony, subject to variation in special cases :—

Crop and type of land.	Uniform Gradient.	Variable Gradients.		
		First 100 yds.	Next 200 yds.	Remainder to outlet.
Tobacco on sandveld, normal rainfall ...	1/400	1/600	1/400	1/330
Maize, etc., on steep or badly gullied land...	1/400	1/600	1/500	1/400
Maize, etc., on moderate slopes, land in good condition...	1/600	1/1000	1/600	1/400
Areas of low rainfall	1/800	1/1500	1/1000	1/800

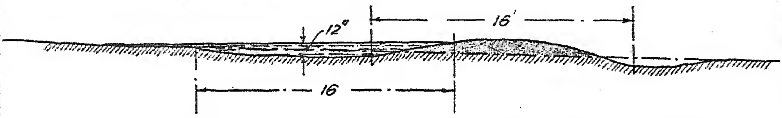
Size and Shape of Contour Ridges.—The run-off from newly contour-ridged land is greater than from one which has been ridged and worked on the contour long enough for all downhill furrows to have disappeared. Damage done as a result of ridges breaking exceeds that done before ridges were constructed. Repair is more costly than proper construction, and ridges always seem to break at the most awkward time. The chief causes of breaks are inadequate size, wrong shape, faulty construction, defective outlets and excessive silting-up.

For land slopes of 1 in 20 to 1 in 40



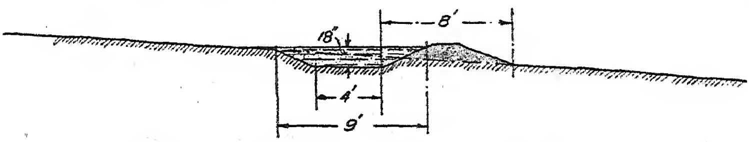
(a) Trough Capacity, (Planted) = 25 Cusecs at $1\frac{3}{4}$ ft/sec

For land slopes flatter than 1 in 40



(b) Trough Capacity, (Planted) = $15\frac{1}{2}$ Cusecs at $1\frac{1}{3}$ ft/sec.

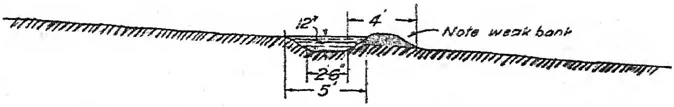
For land slopes steeper than 1 in 20



(c) Trough Capacity, (Rough) = 20 Cusecs at 2 ft/sec.

Note: The above three ridges will be safe during severe storms if properly maintained.

CORRECT SHAPES OF RIDGES MADE WITH DITCHER & PLOUGH



(d) Trough Capacity, (Clean, Smooth) = 7 Cusecs at $1\frac{1}{3}$ ft/sec.

Note: Only safe for 3 acres catchment if kept clean and properly maintained

COMMON TYPE OF INCORRECT RIDGE.

(HAND MADE)

— FIG. 17. —

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17.2.37

Contrary to popular belief, contour ridges need not break under severe conditions. Farmers often complain that ridges are all right in light rains but are bound to fail in a heavy storm. This is not the case. Good farming alone should make every drop of the light shower penetrate, and the ridges should be strong enough to take off all the water that cannot penetrate from a really heavy storm.

The trouble in the past has been that farmers, with very few exceptions, have not built their ridges to the sizes which have been recommended. The ridges shown in the first three sketches of fig. 17 are lower than those recommended in the past, but are still capable of handling the severest storm likely to occur. As an example, consider a storm of 4 inches in an hour, or an equivalent rate of precipitation. Assume further that the area between the two ridges is 7 acres, the maximum recommended, and that the soil is wet, smooth and clayey, which is conducive to a heavy run-off. The three ridges mentioned will handle the flow from such a storm, provided that there are no weak places, defective outlets or actively eroding gullies.

Fig. 17 (a) gives the size and shape of a ridge suitable for land of average slope, and is purposely made broad and as low as possible in order that it may be planted to crops so that no land is wasted. The photograph in fig. 18 shows an example of a ridge of this type. The actual cost of construction, by ditcher and disc plough, for 1 mile of this ridge was a span of oxen, driver, leader, and 3 natives for 4 days. After reaching the stage shown in the photograph, 15 to 20 boys are required for a day to trim that length to the shape shown in the sketch.

A ridge of this construction can be allowed to silt up slightly, but should be cleaned out in the first few years, after which, if the land has been properly farmed on the contour, the run-off and therefore the silting, should have been considerably reduced. The trough must not be filled by ploughing, which should be carried out as described under "Maintenance" and as illustrated in figs. 35 and 36.

Fig. 17 (b) shows a useful shape for a ridge on comparatively flat lands. This ridge can be ploughed over as well as

planted, and can be maintained in proper shape by ploughing only (see fig. 35). It will not take as much water as fig. 17 (a), but as it is not likely to silt up and as sharp storms do not run off so fast on gentle slopes it should deal easily with similar intensities of rainfall.

Fig. 17 (c) shows a "single-sided" ridge suitable for slopes steeper than 1 in 20. The construction will be described later. A ridge of this type is safe on steep lands, because for the spacing recommended the ridges will be moderately close together and the area draining into a full-length ridge will be only 3 or 4 acres.

Fig. 17 (d) shows a ridge which is all too common, and consists only of a small trench and bank. Many farmers have ridges of this size, though they really believe they are much bigger. Actual measurement with a tape-measure would alter their opinion. The trough easily chokes, and the falling in of the sides and bank restricts the carrying capacity, which at best is about one-third of the other types. The bank cannot be cultivated, and is usually left to breed pests and weeds, and harbour rats, which are eagerly sought by natives. Ridge No. 17 (c) is far more satisfactory if narrow ridges are required, as on tobacco lands, and can be planted to crops like sunnhemp or sunflower, when they also act as wind-breaks. The trough may be clean cultivated. Eventually tobacco may be planted on the ridge.

After a few years nearly all crops grow better on the disturbed soil than elsewhere. There are therefore many reasons in favour of ridges that can be planted.

In the calculations of the carrying capacities of the ridges, no account has been taken of the backing up of the water on to the land, since the water here is shallow and its flow is restricted by standing crops. It does, however, serve a useful purpose by acting as a reservoir which stores extra water during a storm, and smooths out the effect of short periods of very violent rainfall.

The velocities shown in fig. 17 have been calculated for a gradient of 1 in 400, and for the ridges running *full*. This, of course, would only happen under the most violent conditions, and for ordinary rainfalls the velocity of flow would be

slow enough to promote silting. The first three ridges can be planted (including the troughs of the first two) and the obstruction due to crops has been taken into consideration in calculating velocities. The ridge in 17 (d) requires the trough to be kept clean if it is to carry even the small discharge shown, and this ridge requires regular maintenance and frequent inspections.

The first three ridges shown in fig. 17 are sufficiently substantial not to need checking after construction, except at obviously dangerous points. They do not require careful and regular inspection after every heavy rain, except after the first storm, as a routine precaution, and maintenance is reduced to a minimum. It therefore pays to build substantial ridges of this type, which will cause no anxiety in heavy storms and require practically no personal attention for several years. That is the secret of really cheap, satisfactory and trouble-free contour ridges.

Benefits of Contour Ridges.—The primary object achieved by contour ridges is the control of erosion, and this is obtained *directly* by the ridges themselves, and *indirectly* by the fact that, on all but the flattest land, all farming operations must be carried out *on the contour.* This is the greatest benefit of all, as it not only prevents erosion, but tends to hold the water where it falls and secures more uniform absorption.

That is the second great benefit of ridges, that they encourage water conservation, which carries the crop through a drought and makes it more resistant to disease, replenishes the deep supplies underground and so strengthens the yield of wells and boreholes and keeps the vleis and streams going months after the rains have finished.

By a paradox, contour ridges also improve wet land, which usually lies at the foot of a slope, and when the upper lands have been ridged the water is prevented from reaching and lying on the flat lands below. That is to say, the water is retained where it will do most good.

In other words, the benefits of contour ridges are even more apparent in abnormally wet or dry years than in normal seasons.

After ridging the land above a pan that was formerly water-logged, the pan can be safely drained by ridges of the type shown in fig. 17 (c), on a slightly steeper gradient than normal.

By preventing the movement of soil, contour ridges prevent fertiliser, humus and other plant food from being washed away. Thus, although they do not actually create an increased crop yield, they prevent wastage, and ensure that *full* value is obtained from fertilising and green-cropping, so that a programme of good farming can be undertaken in the secure knowledge that it will not be wasted. Calculations based on the experiments at "Glenara" go to prove that to replace the plant food removed each year by erosion on unprotected lands would cost in the region of at least £2 to £3 per acre at current market prices.

Much of the plant food is present in virgin soil. It should not be wasted merely because it is free, and farmers should realise that it costs money in fertiliser and more frequent green-cropping to replace it.

When a land has not only eroded, but has been cropped regularly for a long time without fertilising or green-cropping, it is too much to expect a jump in crop yield immediately it has been ridged. The land must be properly farmed and treated for some time, and then the real benefits of contour ridges will be felt. It pays to get a good crop as soon as possible, and if the soil is badly impoverished a green crop should be planted the very first year and fertilised to make sure that it is a good one. Special loans are available to enable farmers to fertilise green-crops planted on recently protected lands. Recommended green-crops are sunnhemp, or sunflowers and velvet beans interplanted.

It is difficult enough to grow a bumper crop even in a good season. Soil conservation, which includes both protective work and good farming, should make a good crop certain even in unfavourable seasons, when prices are best! The few farmers who regularly produce yields which are relatively high for their districts will be found to practice soil conservation in the wider meaning of the term.

Witchweed thrives on eroded land and impoverished crops. It grows thickest on the edges of washes and small gullies as it is spread by the flow of water. Storm-drains cut off the seed at the source of supply, and contour ridges isolate patches of infestation and prevent their spreading. A ridged land can be readily divided up into sections to suit the various methods of control required on various parts of the land. For instance, the strips between certain ridges can be planted to a crop other than maize, others can be trap-cropped, and the remainder hoed to eradicate the weed.

Reverting to the question of controlling moisture, there are cases of low-lying land which have been bogs in summer and cracked and dry in winter, and so are useless for pasture or for growing crops, except under the most favourable rainfall conditions. When the land above has been ridged, the more even distribution of moisture and the seepage during the winter enable them to be used successfully for pasture or good crops respectively. Similarly, the moisture content during the winter in a wheat-land can often be improved by ridging the land above.

CHAPTER IV.

CONSTRUCTION AND MAINTENANCE OF RIDGES, Etc.

PRELIMINARY WORK.

The Line of Pegs.—On ground which frequently changes slope the ridges should be built just below the pegged line, so that the trough follows the true line of levels.

The pegged line may be straightened *slightly* so that any sharp bends due to very local inequalities are smoothed out. This should be done with caution, however, particularly on steep ground. When a peg is moved, the new position should not be more than 3 inches higher or lower. This means that pegs should not be moved more than 3 or 4 feet on steep ground or 5 or 6 feet on moderate slopes, unless particular care is taken to determine the new level, and extra height (and width) is added to the bank accordingly. Pegs should seldom be moved *uphill* further than the allowance mentioned above, since a cutting is more dangerous than banking-up, as it is so easily filled in and blocked.

Sharp bends in the last 100 feet of ridge should *not* be straightened, since there is frequently a hollow and bank at the edge of the land due to ploughs turning, and there is serious risk of the outlet level being considerably higher than the trough of the ridge at this point. The ridge should be banked up as shown in fig. 24 (lower illustration).

If pegged lines have been straightened to any extent, an inspection should be made after the first heavy storm, when the level line left by the water standing behind the ridge will show up weak places. This inspection should never be omitted.

Crossing Gullies and Wash-outs.—In cases where it is intended to plough over the ridges, it is a waste of labour to straighten the ridge and build up high banks, and the line can follow the sharp bend caused by the depression. The line will only be pegged in this way when requested, and the levels of the top of the ridge and trough should be carefully checked after construction.

Normally, however, the ridge is taken almost straight across a gully or wash-out, and the bank must therefore be built correspondingly higher. It simplifies subsequent construction if the gully is first filled up to the bank level, as shown in fig. 20. Mark the positions of the toes of the embankment required by pegs in the bed of the gully, placed (both up-stream and down-stream) at a distance from the pegged line equal to twice the depth of the gully plus the height of the ridge itself (18 inches). Measure the depth of the gully by stretching a 100-foot string between the pegs originally placed on each side of the gully, and not merely from the bank of the gully.

The actual filling (up to the level shown by the string) can be done by knocking in the sides of the gully for some distance above and below, and ploughing in the sides to obtain material. The embankment can then be built with a land-leveller (fig. 27) or, for big banks, a dam-scraper. The correct method of using a dam-scraper, to obtain the soil from the proper place, is shown in fig. 21. In other cases, sufficient soil may be obtained from a near-by antheap, thus killing two birds with one stone. The top of the embankment at bank level should be not less than 9 or 10 feet wide, and the ridge

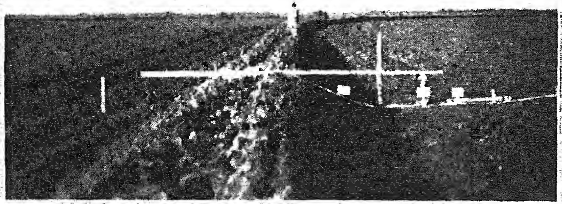


FIG. 18. DITCHER & PLOUGH MADE RIDGE; FOR DIMENSIONS SEE FIGS. 17A & 29J.

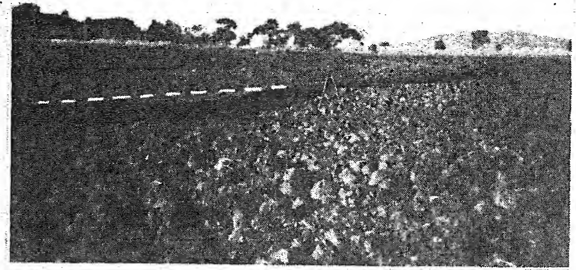


FIG. 19.

RIDGE CROSSING A PREVIOUSLY UNAPPARENT DEPRESSION

BUILD-UP TO DOTTED LINE

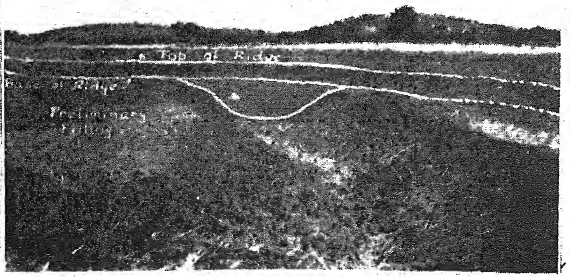


FIG. 20. BUILT UP CROSSING OF RIDGE OVER A BIG GULLY.

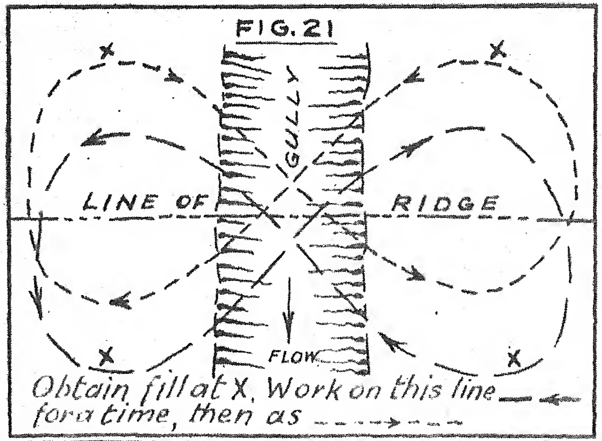


FIG. 21.

METHOD OF WORKING DAM SCOOP FOR FILLING UP GULLY CROSSING

itself can then be made up to full height by continuing to use the dam-scraper or leveller as before. All earthwork, even when consolidated by using a dam-scraper, is liable to settlement, and at gully crossings it is very important that the top of the ridge should be raised to an extra height. The extra height allowed should be 2 inches for every foot of height. Thus for a gully 3 feet deep the top of the ridge at the crossing should be 6 inches higher than the top of the ridge at the nearest pegs. This should be carefully checked, even at small gullies, by a string-level or boning-rods, which are described later.

Gully crossings should never be built, wholly or partly, of stones or posts. Such construction weakens the embankment, as the soil shrinks away from stones or posts, and water is admitted or rats get into the bank.

Gullies continue to carry silt even after the land has been ridged, and this silt is deposited, often in high banks, against the ridges, which frequently burst as the result of such obstruction. Small checks, of brushwood and earth, should be built across the gully about 10 yards above the ridge and, if necessary, at other intervals further up the gully. In this way the silt is held up before reaching the ridge. This precaution should in particular never be omitted in sand veld.

The Construction of Contour Ridges.—Each type and condition of soil requires some modification in the method of construction. Different kinds of implements work best on different soils. No ditcher, dam-scraper, leveller or plough works economically on wet sticky soil or on hard dry cloddy soil.

The best time for sandveld is when it is wet or damp, and for heavier soils when they are just dry enough not to stick to an implement. In spite of certain contrary opinion in the past, this is also the most convenient time to build ridges, at least, in the opinion of those farmers who are doing the most work. Fallow sandveld lands can be ridged any time during the wet season, green-cropped lands on all except wet black vleis can be done at any time from one month after "ploughing-in," and many lands under side-crops are clear from then onwards.

On most well-run farms, therefore, about one quarter of the lands will be available at the time that the soil is in the best condition for building ridges economically and well. At this time of year there is little work for oxen, they are fit, grazing is plentiful, the temperature moderate, and the soil is soft, whereas in September and October the conditions are just the reverse. The moral is to do as much of the work as possible before August, and in a surprisingly few years the whole farm will have been done.

A farmer without previous experience of ridges should not take on too much the first year. It is better to gain experience on a smaller scale, and do it properly, than attempt too much and have extensive failures. There are many little points to be learnt as the work proceeds. It is easier to make good ridges than to repair defective ones, and easier to make them a little too high than to raise them later. Maintenance during the wet weather is costly and trying, and a broken ridge does more damage than none at all. Properly-made ridges will stand everything but freak storms. After making the first ridge, measure it up honestly with plank, spirit level and tape, and compare it with the recommended size, which is none too big, and see that all is well for height and *width*, particularly at dangerous points.

Some farmers make ridges that do not break, others are surprised when they break, and others expect them to break. If correct methods are followed, and a little trouble taken, there is no need for any breaks at all.

METHODS OF CONSTRUCTION.

(1) *By Hand-labour.*—Owing to our cheap labour, and the many cases such as tobacco farms where a large gang is idle at certain times of the year, or is available at odd times, many contour ridges, especially on a small scale, are built by hand. There is nothing against it, if the common faulty type of ridge, fig. 17 (d), is avoided, and ridges are built to a substantial size, such as 17 (a) or 17 (c). Soil should be taken from both sides of the ridge, and if the land has been ploughed (and harrowed, if cloddy), fairly rapid progress can be made, and the daily "task" of finished ridge will be between 15 and 25 yards per native, depending on the type and depth of soil.

The ridge should be a full 18 inches high (above original ground level), should have stable side slopes and must not be brought to a pointed crest but should be well rounded off. Hand-made ridges are more liable to settlement than those made by the other methods described later.

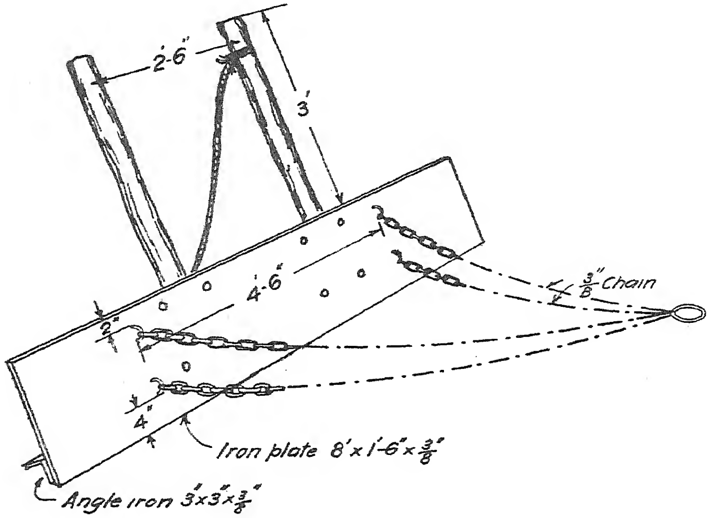
(2) *By Dam-scraper.*—This method appeals to many farmers, and has several solid advantages. It is a cheap implement, requires changes of only 4 to 6 oxen, is simple to operate, requires very little supervision, produces an exceptionally well-consolidated ridge, and does not leave a defined deep channel if properly used. The chief disadvantage is its slowness compared with a ditcher, and therefore a slightly higher cost per mile. A good rate of progress can be maintained if 3 or 4 scrapers are used simultaneously, as each scraper, with a driver, leader and "operator," and 4 to 6 oxen, can build 100 yards of finished ridge per day.

The line of the ridge should first be marked by ploughing close to the line of pegs on each side, throwing towards the pegs. If the land has not already been ploughed, the ploughing should be continued over a strip of at least 15 yards.

The method of working the dam-scraper is illustrated in fig. 28, the point about it being that the team makes the same-sized turn the whole way, and each time it crosses the line of the ridge it dumps a load next to the load placed on the previous crossing. The team should make a turn sufficiently large to cover the whole of the ploughed strip, and it is important that a *skimming* cut should be used, beginning at least 5 or 6 yards from the ridge, and not attempting to dig in deeply and pick up all the soil next to the ridge, which is hard on the oxen and produces a bad shape.

If the correct procedure is followed, a well-shaped rounded ridge similar to fig. 17 (a) will be produced after a few repetitions of the process described above, and the ridge will be well-consolidated by the trampling of the oxen and of an easy shape for planting. Maintenance is reduced to a minimum, and can be carried out as described in a later paragraph.

An advantage of using a dam-scraper is that the same implement is the best suited to filling up gullies and wash-outs.



"Evans" Leveller for 6 oxen

Fig. 27.

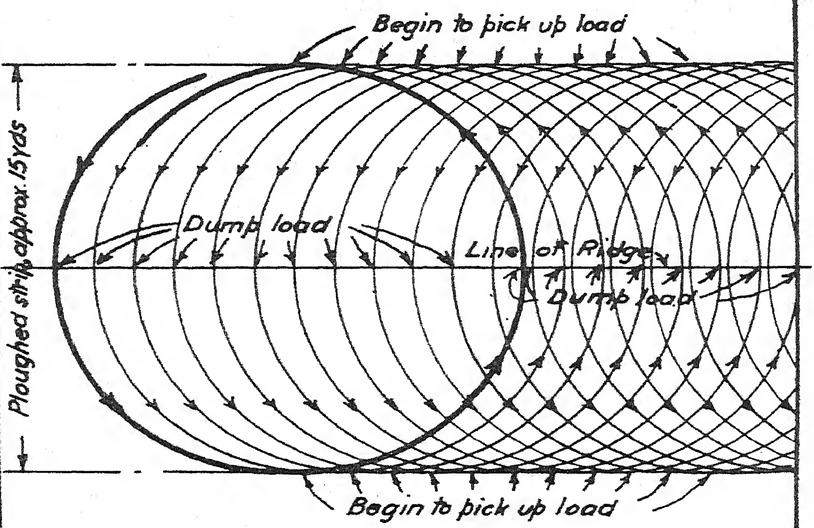


Fig. 28.

Diagrammatic sketch showing method of working dam scraper when making ridge

(Heavy line indicates first complete turn of scraper.)

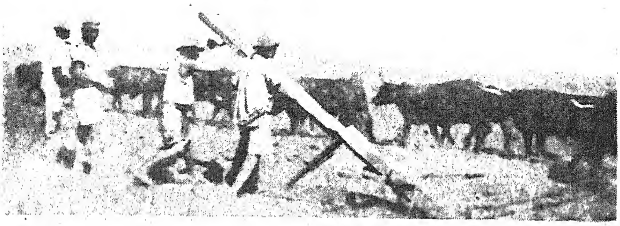


FIG. 25. MARTIN DITCHER FITTED WITH AN EXTENSION

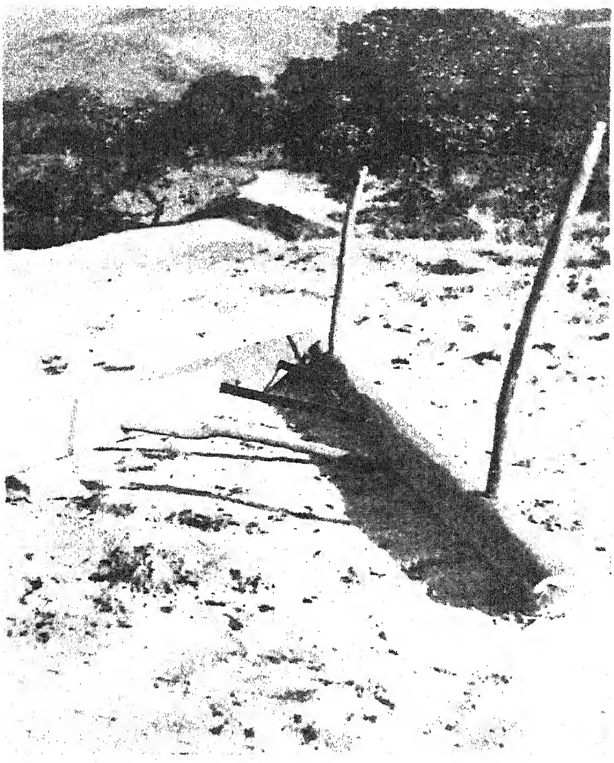


FIG. 26. NATIVE DEPT. DITCHER

(3) *By Land-leveller.*—The procedure is exactly the same as for the dam-scraper, but with more particular care in the correct method of turning. Short turns invariably overturn these implements.

The Hobson type of land-leveller consists of a blade, usually concave, with long lifting handles running backwards, and either a runner or wheeled carriage or else a long dissel-boom or shaft in front. The load is picked up by pressing the handles, and dumped by lifting them. While quite suited to levelling land, the work of making contour ridges is exacting and tiring to the operator, as he has alternately to press down the handles to pick up a load, and then raise them at least 3 feet in order to lift the heavy implement over the bank.

The Evans type is a simpler design, and needs no great strength, but only a certain knack. It consists of a sheet iron plate (or timber with an iron bottom edge), 6 to 8 feet long and 18 inches high. Four chains are fixed to it by shackles, and joined together at a ring by which it is pulled. Two wooden handles are bolted to the plate.

When required to pick up a load, it is held in the position shown in fig. 27. To dump, the handles are pushed forwards and released, when it will fall flat. By pulling or pushing the handles, the amount of pick-up or dump can be varied.

A short rope is usually tied to the top of the left-hand handle. To pull up the implement, a sharp pull is given on the rope and as the blade comes up the right-hand handle is caught. To pick up a big load it is advisable to stand on the implement, and, if the chain-lengths are correct, balance is easy and the operator stands straight, merely touching the handles.

(4) *By Ditcher and Plough.*—For ditcher work a great deal depends on the plough, which should be put in first-class order. Except in very soft soil a disc-plough is needed. There must be a minimum of slack in the bearings of wheels and discs. The steering levers must be without slack, and the lifting levers should work smoothly. New 26-inch discs are most desirable. It is impossible to make big ridges with worn discs, and even the number of rounds is doubled. One cannot steer on smooth curves if bearings are slack and the plough out of alignment.

The Ditcher.—Fig. 25 shows the size and shape of a typical implement. The land-slide, that is, the part that runs in the plough furrow, should be at least 10 feet long, but there is little gain in having it longer than 12 feet. The grader blade should be at least 9 feet long for dry cloddy soil, and up to 12 feet for damp or loose soil. Some makes of ditcher require an extension, clearly shown in the photograph, fitted to the grader blade. When opened to give a "width" of 6 feet, the angle will be about 45° for the 9-foot blade, and 30° for the 12-foot blade. These are the greatest angles at which the soil will slide up.

The grader arm should be strong, yet light enough for one native to lift up the outer end easily. There is no need for a ditcher to be excessively heavy in order to be strong. Lightness and strength are matters of design. The grader arm should have twin front stays, to prevent its twisting. When the cutter hits a rock and the oxen are hooked up with a jerk, the blow acts as a twisting force on the arm, and the hinge-pin cannot stand it alone. If the grader-blade leans forward, the soil is packed down instead of being pushed up. A "compensating" extension stay as seen in fig. 30 is also advisable, as it takes up the thrust automatically where greatest.

Striking out the Marking Furrow.—Place a line of pegs long enough to be seen from the plough-seat, one at the side of each "level" peg. Where the slope of the land is irregular or changes violently, the long pegs should be placed 4 to 6 feet below the original pegs, so that the "trough" will be made exactly to follow the original line. This is the time to carry out any straightening of bends in the original line, and the pegs after being moved as previously described should all be the same distance from the new, long "sighting" pegs, and will form a valuable guide after the latter have been knocked down.

"Striking-out" with a single-furrow mouldboard needs no further explanation. Neither the gang mouldboard nor the two-furrow reversible disc plough is a really suitable implement for marking smooth curves. The three-furrow disc plough when correctly used is a most suitable implement, and

does a lot of the work of actually pushing up the soil to form the ridge, besides loosening it, so that the ditcher can work with maximum efficiency.

The plough is entered at one end of the line of pegs so that on this trip the slope of the ground is down on the right-hand side and the furrow is thrown downwards. It is adjusted so that the front disc barely scrapes the soil and the back disc ploughs about 6 inches deep. The seat of the plough is over the back disc, and this is taken as the line. The team then sets off, and is controlled so that the operator himself travels over the line occupied by the long pegs (fig. 29 (a)). By sighting on two or three pegs ahead, very smooth curves can be made, and a check is kept by observing the original pegs as they are passed. The team is kept straight ahead of the plough, the leaders only swinging round the bends when the plough gets to them. It is impossible to make a smooth curve if the leaders follow the line and an attempt is made to control the plough by using the hind oxen and the steering lever excessively. It is most important to avoid kinks, as they will throw the ditcher out of the furrow.

At sharp bends or if the team is not straight, stop and put the team in the right direction by gentle methods. The oxen will then learn quickly. Do not allow the driver to hit the oxen, hurry them or get on the off-side. Ignore the hind oxen and use the steering lever to a minimum. Rely on the leading oxen. Have an intelligent native as a leader.

On reaching the far end, the plough is entered for the return journey below the pegs, so that it throws towards the first furrow. To avoid overturning the plough on a sharp right-hand turn, make a "figure of eight" turn by first swinging to the right and then turning to the left.

Usually on the return journey the front wheel follows the track it made on the forward one, but the exact line depends on the final width of ploughed strip that is desired, according to the state of the soil and the size of the ditcher. The completed width of the strip (after two rounds) should be twice as wide as the best width of the ditcher for the soil conditions. A ditcher does not work well if opened wider than 30° for damp soil, 40° for dry soil and 45° for small clods.

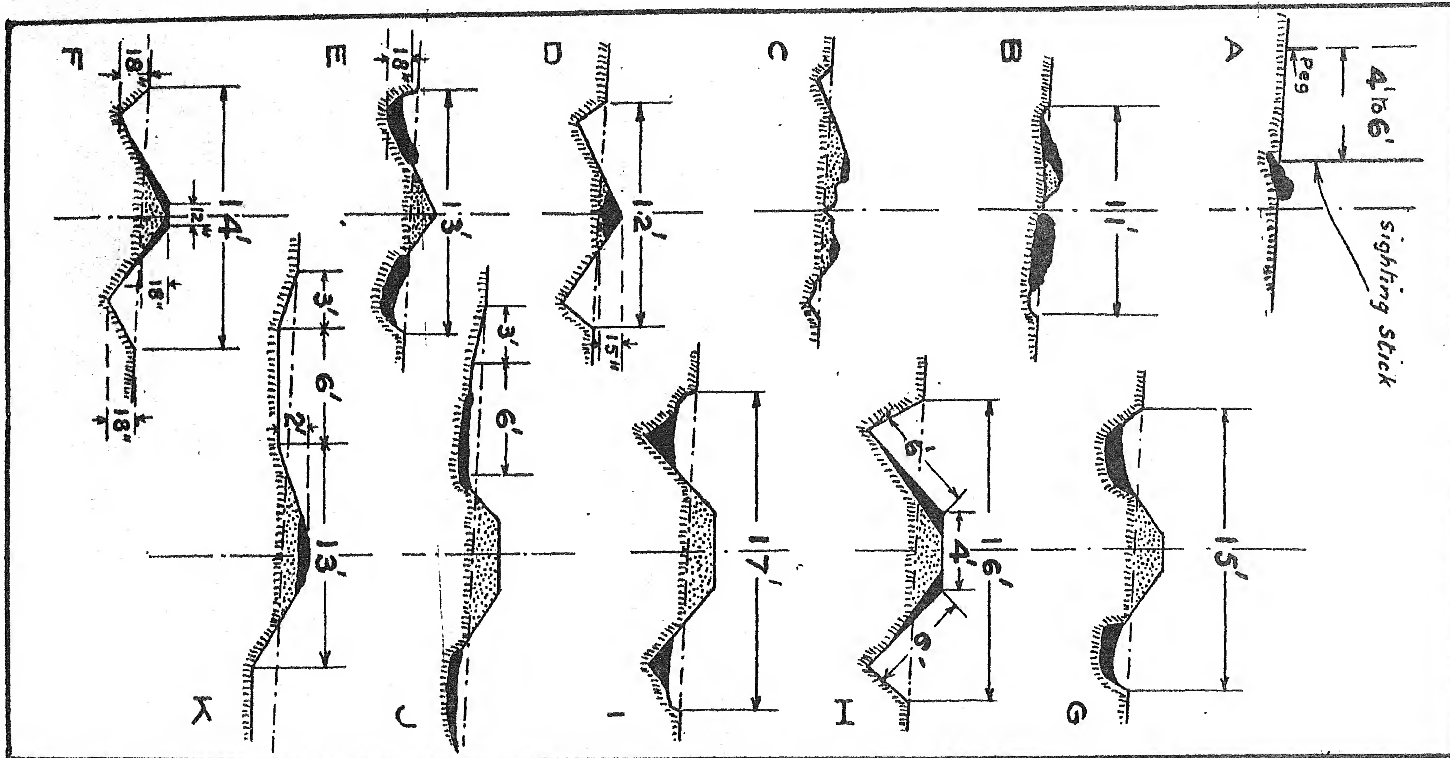


Fig. 29. Stages of construction of Ridge with Ditcher and Plough.

To begin with, it is as well to keep slightly on the narrow side, but most important of all is to keep the width constant, or the ridge will sometimes be too pointed and sometimes too wide.

On returning to the starting point, the plough goes round once more (fig. 29 (b)), ploughing new ground as for ordinary ploughing, but the levers set for maximum penetration of the back disc, at least 9 inches, if possible 12 inches. The front disc may be lifted half out to reduce draught and avoid a tendency to crab. If still inclined to crab, move the "hake" or "clevis" slightly to the right.

The strip should now have been ploughed as shown in the cross-section, fig. 29 (b). It should be about 8 feet wide for damp soil, and up to 12 feet for very dry soil. If the soil is too hard to plough deeply without bringing up large clods, it pays to re-plough the strip. When this is done an unploughed strip one foot wide must be left in the middle of the strip, and the first two rounds described above are ploughed shallow. The plough is then entered with the front wheel in the centre of the unploughed strip, and two more similar rounds completed. It is most important to have this centre strip, which serves as a guide and a grip for the front wheel.

The Ditcher.—The ditcher is next entered with the land-slide in the furrow and the grader-arm over the strip, held up waist-high at the end. Two natives weight the land-slide. See figs. 30 and 29 (c). The first round is intended to clear a furrow for the ditcher to run in the following round. Take great pains that the ditcher does not kick out, for if it does it will do so afterwards every time at the same point. The hitch clevis should be in the hole nearest the land-slide. Use about 3 feet of hitch chain and any recognised means of relieving the downpull on the hind oxen. One line of oxen walks in the furrow and the other *on the ploughed strip*, except on curves, when they must be kept straight ahead. It may assist to work the ditcher throwing to the left, as then the off-side oxen will walk in the furrow. Fig. 30 clearly shows the position of the oxen. If they are used to ploughing and are hit, they will take up a position as for that work.

If the soil sticks to the blade, this can be overcome by leaving the turned up soil to dry for a day before entering the ditcher. Also, if a green-cropped land has just been ploughed a sufficient time should be left for the soil to settle. The land-slide of the ditcher must have a firm furrow to press against.

With the next round of the ditcher the work of pushing up the soil begins. It is entered as before, but the native on the arm only lifts it when crossing places where liable to kick out. The live load on the land-slide is adjusted if necessary. See fig. 32. Do not press down the arm, but rather lighten it by pulling on the post. One or two more rounds now follow until the size approximates fig. 29 (d). Some weight may now be put on the arm. Usually a live load of two boys is ample, and pressure is applied by pushing inwards on the post. If the tail tends to kick out of the furrow, or the nose run in to the centre of the ridge, move the hitch clevis *in* one hole. The shape of the "peak" depends on the width of the ploughed strips, and how the soil has slid up the arm. By this time the correct width of ploughing and the best opening of the ditcher should have become obvious, and can be adopted for the rest of the ridges.

Further Stages.—The plough is now used to deepen the bottom of the V furrow and also take in about 6 inches of new ground. Adjust the straps or other device so that on the land-wheel side the frame can be lowered almost to touch the ground. The plough is entered in the furrow so that only the back-disc is biting new ground, and it is going in as deep as possible. Eighteen inches total depth is easily attained if the settings are correct. See fig. 29 (e). The oxen walk in the same position as in previous rounds. (Fig. 31.) This operation is quite easy if the plough is in good order, and no attempt made to hurry the oxen. The team must be kept straight. The width of the cut must not vary.

Three or more rounds of the ditcher now follow. If the "V" ditch is deep and clean-cut the oxen may now take up positions as for ordinary ploughing, but the hitch must be adjusted accordingly. As before, the first round clears the furrow, and though only a pull on the pole is generally required, the arm must be lifted at all weak places. For the succeeding rounds some pressure must be applied to the arm,

FIG. 30

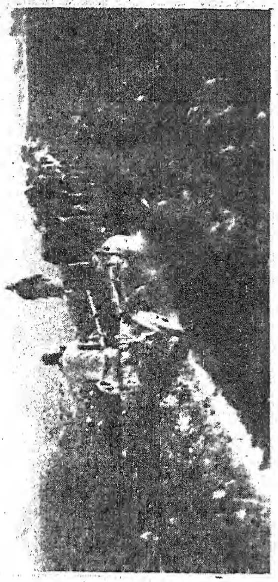


FIG. 31.

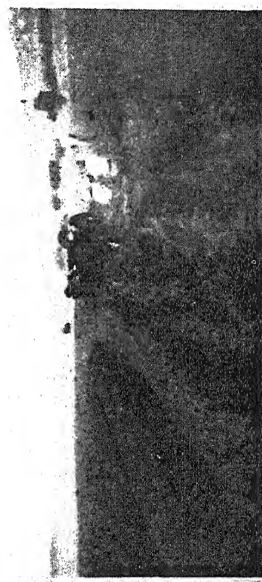


FIG. 32

FIG. 33

CONSTRUCTION OF RIDGES BY DITCHER

FIG. 30. THE FIRST ROUND WITH THE DITCHER.

FIG. 31. PLOUGHING TO OBTAIN MORE FILL.

FIG. 32. GRADING UP SOIL LOOSENED IN FIG. 31.

FIG. 33. FILLING IN THE "V" DITCH.

but a small amount of soil should be allowed to slip under the top end and be packed. If too much pressure is applied, an impressive amount of soil comes out at the end, but most of it rolls down again. Fig. 29 (f) shows where the soil must be packed to widen and slightly raise the bank.

The plough is now used again to widen the furrow slightly and deepen it as much as possible. Fig. 29 (g). This is followed by several rounds of the ditcher.

A further cycle of plough and ditcher may be needed, but by now the bank should have the dimensions given in fig. 29 (h).

If necessary, the ditcher may be opened wider in the later stages, but efficiency is greatly reduced, especially after the slope has become steep. When the widest angle at which soil readily slides up has been found it is as well to keep it. All the ridges in the photographs were made without altering the angle of the ditcher.

Useful Hints.—The ditcher can be steered a bit at the early stages by changing the position of the load.

As the load on the arm is increased, adjust the hitch clevis by moving it in, but always so that more side pressure is exerted at the tail than the nose.

By lifting the arm at gully crossings, not only is skidding prevented, but some extra earth is deposited.

A perfectly even finish to the side slopes is obtained by pressing down the arm on approaching lumps and pulling upwards at small hollows.

If clods are troublesome, reverse the ditcher each trip and it will push them up.

Remove all roots, stones, etc., that are met.

Keep a high polish on the grader-blade.

Filling in the V ditch is next done by the plough. As the ditch may be up to 24 inches deep the plough cannot take a full cut, so it is run along with only the back disc taking a bite, but this time set shallow. This forms a step, fig. 29 (i). The next round the front wheel runs on this step, and this is

followed by another round outside. The plough then makes 3 or 4 more rounds, starting as close as possible to the ridge on the first trip, and on the final trip when it is about 6 feet away from the ridge it is run along merely to close the last furrow, and as shallow as possible. See figs. 29 (j) and 33.

If desired, a small amount of earth can be shovelled out of the trough, so as to make it perfectly level, and used to cap the bank. (Fig. 29 (k)). Fig. 36 shows a completely settled ridge, 18 months old, made like this.

(5) *Ridges made by Single-furrow Plough and Ditcher.*—When sandveld is wet, ridges can very successfully be made by using a single-furrow mouldboard plough.

The marking-furrow is struck out as before, and on the return trip a furrow is ploughed about 10 feet below. It is advisable to mark this with pegs, as the width must be constant. The ditcher is then entered as before, but perhaps set a little less open.

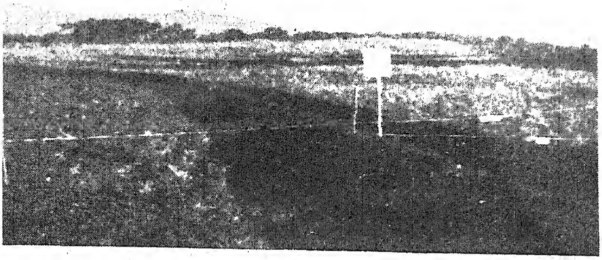
The procedure is as before, except that as the plough has a shallower cut it is necessary to go over the same ground two or three times each time it is wished to widen the ridge.

(6) *"Single-sided" Ridges and Drains.*—On eroded or steep land the single-sided ridge possesses many advantages. (See fig. 34.) There is no V-ditch on the lower side, which in such cases would be difficult to fill, and would collect water which would cause erosion at gullies. Moreover, soil cannot be pushed upwards on a steep slope. The ideal ridge for steep slopes must have a definite trough, which must be kept clear. (See fig. 17 (c)).

To build this ridge, proceed exactly as before, working *both sides* until the stage for widening is reached (fig. 29 (e). Then the plough on its return trip either returns light or is utilised for ploughing; and the ditcher is reversed each time, so that from then on its works on the upper side only. Otherwise the cycle of work continues as before.

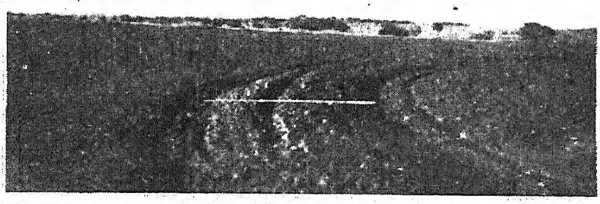
(7) *Ridges made by Disc-plough only* are very suitable for flattish lands (*i.e.*, slopes less than 1 in 40). The first strip is ploughed as for hard soil, *i.e.*, an unploughed strip one foot wide is left in the middle. It is usual to make

FIG.
34



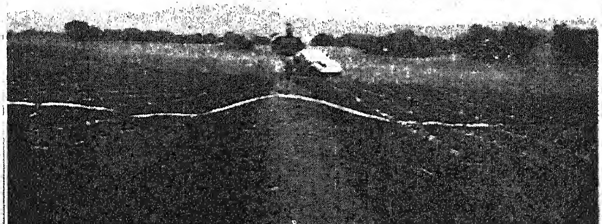
SINGLE SIDED DITCHER-MADE RIDGE
SEE FIG. 17c.

FIG.
35



MAINTENANCE OF RIDGE BY PLOUGHING
SEE FIGS. 17B & 37.

FIG.
36



RIDGE AS FIG. 17A, 2 YEARS AFTER
CONSTRUCTION, ALSO SEE FIG. 38.

3 rounds, followed by 3 or 4 rounds starting in the centre, a total of 6 or 7 instead of 4. The plough then starts in the centre again, and as the soil is now loose, it will sink in deeply and push over the soil. It is moved out only 6 to 12 inches each round, thus taking about 8 rounds to reach the edge. A bank is very soon formed. The hollows either side are filled and smothed by two rounds outside, throwing inwards.

If the soil is just damp, a total of under 20 rounds with 26-inch discs will make a very broad ridge suitable for working over, but the spacing must be a little closer than usual. Under these conditions the plough alone can be more efficient than the ditcher and plough method. This type of ridge can be maintained by adjusting normal ploughing without extra work.

Types of Ditcher.—There are several makes of ditcher on the market, such as the "Martin," "Lockie" and "Morris," each capable of good work under suitable conditions.

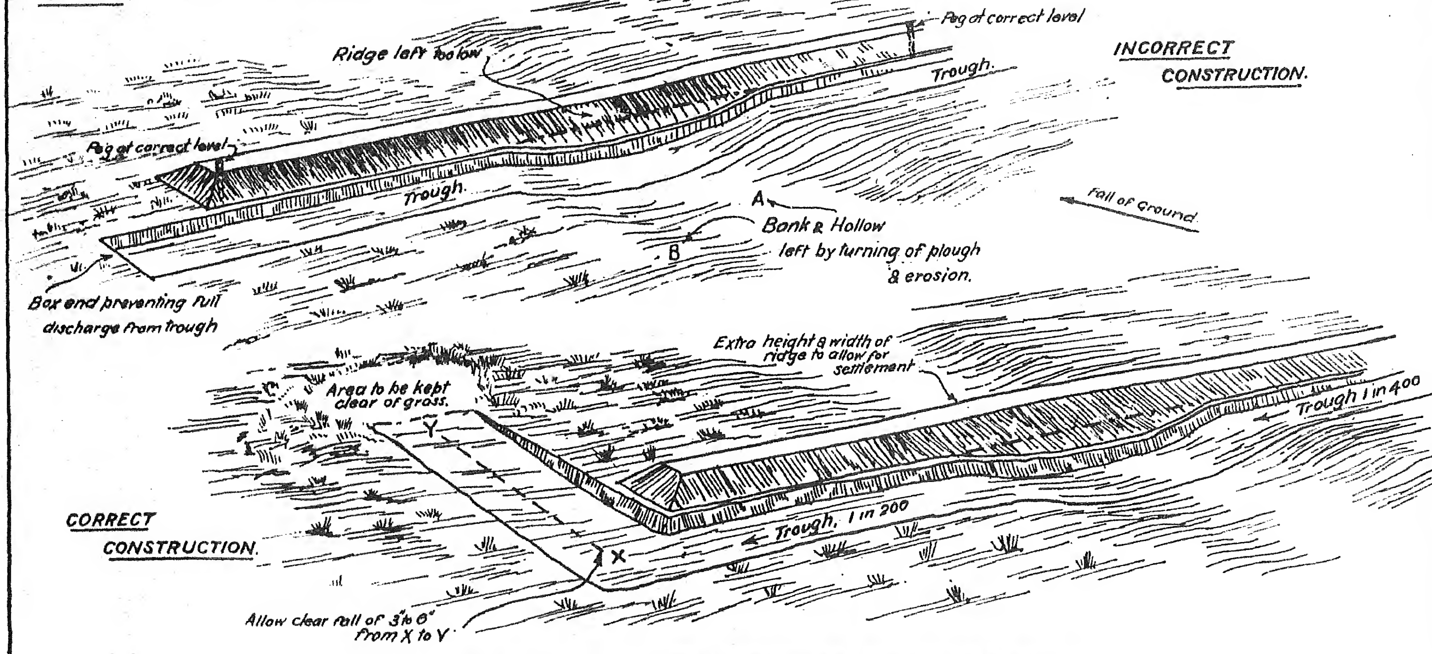
Two types of home-made ditchers were fully described and illustrated in S.R. Departmental Bulletin No. 961, "A Home-made Ridger."

A cheap implement recently developed by the Native Department is illustrated in fig. 26. It consists of a gum-pole 12 feet long (the land-slide), a steel railway sleeper flattened at the ends (the grader-arm) and two iron struts, 18 inches and 36 inches long respectively, the grader-arm being set at an angle of about 30° to the land-slide. An iron hook is bolted to the pole at the nose of the implement. For building a ridge of any height, the blade should have an extension (as shown) consisting of a 9 in. x 1½ in. deal, the face and corners of which should be protected by a steel plate and angle irons.

This ditcher is reversible, and is capable of good work in light sandy soil. It is hoped to publish a more detailed account of this ditcher at a later date.

Ridge Outlets.—Defective outlets are a fruitful cause of broken contour ridges, although often unsuspected by the owner, who does not always realise that a small trench 2 or 3 feet wide is not enough to carry the discharge from a full-length ridge.

FIG. 24.



RIDGE OUTLETS INTO VELD

Outlets to Veld or Vlei.—Correct and incorrect methods are shown in fig. 24. Just inside the edge of the land it is common to find a hollow caused by the ploughs turning, and a bank is thrown up at the actual edge. It is most important for the ridge to be built up an *extra* height across the hollow, and for the outlet drain to be cut to full depth through the bank.

Furthermore, a common fault is to stop the drain short with a "box-end," as shown. The drain should be given a greater rate of fall than the ridge, and should be curved round down the slope for a sufficient distance for the bed to run out on to the ground level. In addition, there is always the danger that trash and silt may collect in the long grass frequently found at such points, and so obstruct the outlet, and for this reason an area of ground below the outlet should be kept clear of grass.

All such outlets should be checked after construction by the "string-level" (see Bulletin No. 958, "A Cheap Levelling-device") to make certain that a continuous fall has been allowed along the trough of the ridge and the bed of the drain. The top of the ridge may also be checked by means of "boning rods," the use of which is described in a later paragraph.

Outlets to Shallow Drains.—The danger here is that when the drain is flowing full, and the trough of the ridge is not much higher than the bed of the drain, the water in the drain will "back up" the ridge and prevent its proper discharge. In addition, if the ridge is led in at an acute angle or a right angle, there will be a swirl and silt will be deposited. This incorrect arrangement is shown in fig. 23 (on left). The danger can be overcome by curving the outlet end of the ridge downhill as shown on the right of fig. 23, thereby bringing it down to a lower level (a drop of about 6 inches should be allowed) and also producing an easy angle for the flow from the ridge to mingle with that in the drain.

The obstruction to flow at the ridge outlet may also be due to the drain *down-stream* of the outlet not being deep enough, wide enough or steep enough. Attention to these points will often cure the trouble.

Use of "Boning Rods."—Boning rods form a cheap and simple device for checking the uniformity of gradient between one known point and another, but cannot be used for setting out levels. A set of three "rods" is required, each made of a piece of, say, 4-inch flooring board, all exactly the same length, about 4 feet, with a T-piece about 18 inches long nailed across one end, flush with the top. One "rod" is held upright at a point where the level is known to be correct, and a second "rod" at a similar point further along the ridge or drain. The third rod is then held at various points in between, and by sighting the line between the cross-pieces of the first two rods it is easily seen whether the intermediate point is too high or too low.

MAINTENANCE OF RIDGES.

Full-sized Ridges Reduce Maintenance.—Maintenance depends largely on the method of working the land, and on the *size and shape* of the ridges. The sizes shown in fig. 17 may be considered excessive, and it is often thought that an official recommendation errs on the generous side and that a little cutting down is permissible. But let there be no mistake. The sizes now recommended are the smallest that experience has shown to be safe. They require a minimum of maintenance compared with small narrow ridges, but that minimum must not be neglected.

Other reasons against reducing the sizes shown in fig. 17 are:—

(1) An allowance must be made for settlement, especially in hand-made ridges.

(2) A "free-board" (height of ridge above maximum water level) must be allowed, as absolute accuracy of construction cannot be guaranteed.

(3) Silting, especially at gully crossings, will reduce the "carrying capacity" of the ridge. Ploughing and plant growth will do the same. Any such obstruction of filling of the trough, however, must be guarded against by proper maintenance.

(4) Reduction of the height of the ridge by cultivation and "minor erosion."

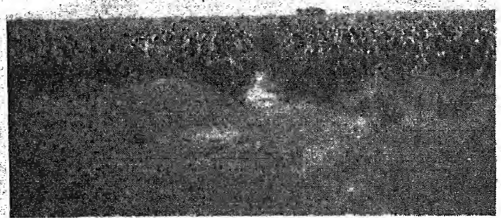


FIG. 22.
RIDGE OUTLET TO VELD

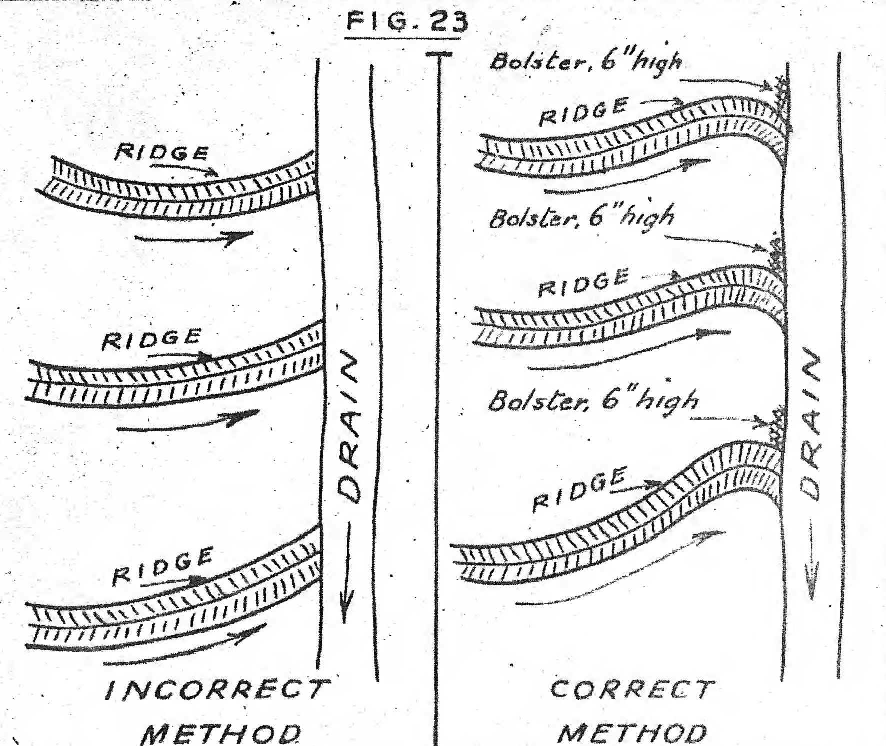


FIG. 23
RIDGE OUTLETS TO SHALLOW DRAINS

(5) The impossibility of exactly estimating the run-off from different lands, due to the wide variation of the factors which control it. Under very adverse conditions the run-off may be three times as great as under good conditions.

It is without doubt more satisfactory to make the ridges of substantial size, and base the need for maintenance on observation of actual results, than to make them too small with the intention of enlarging them later, an intention which is invariably delayed until real damage occurs. Moreover, once a ridge has been built, it is difficult to raise it with a ditcher, although it can be widened.

Reverting to the sections shown in fig. 17, it will be noticed that (a) has a greater capacity than (b) or (c). The capacity of (b) need not be so great, because on flattish lands it takes longer for the water to gather, and the worst intensity of the storm may be assumed to have passed before this occurs. Ridge (c) is to be used on steep lands, and the area between ridges would then be less.

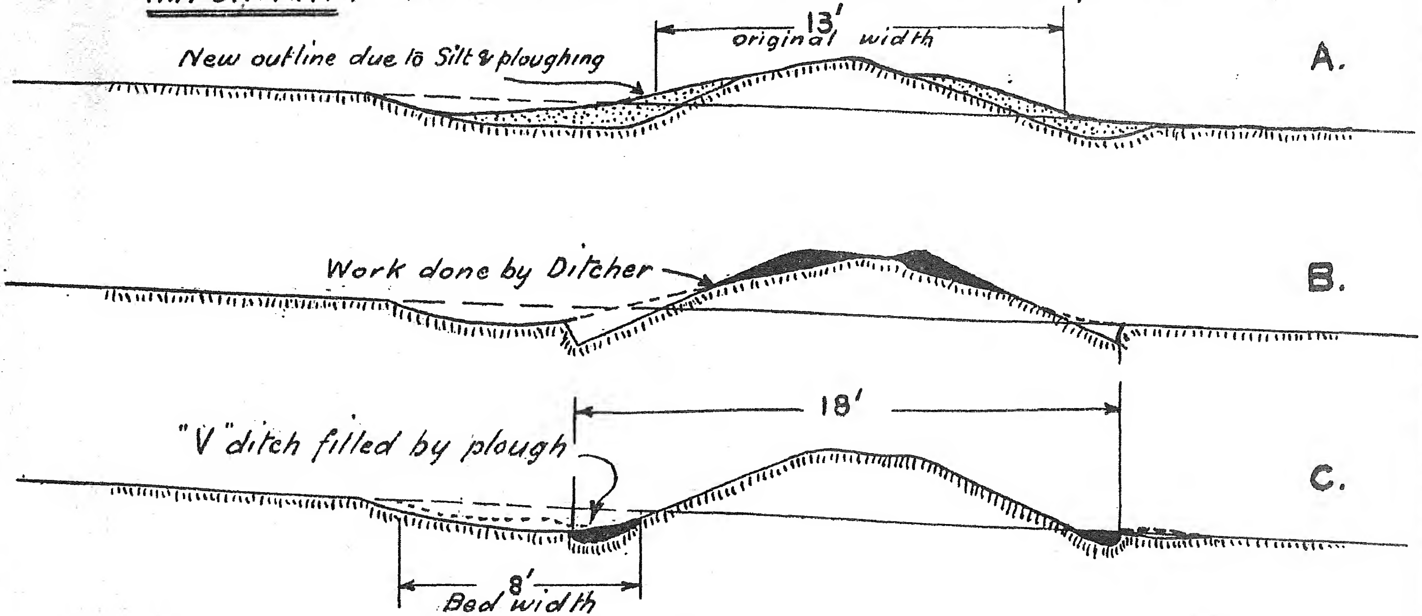
Maintenance.—As a matter of routine all new ridges should be inspected after the first heavy storm, when any weak points will be easily recognised by the "high water" mark, and should at once be attended to. Silt deposits at gullies should be noted. A pool up-stream of a cutting will indicate that the trough in the cutting is not deep enough. Cuttings through antheaps and mounds are undesirable, but if they have been unavoidable, they should be of ample depth and *width.* The *bottom* width of a cutting should be 2 feet for every acre of catchment in clayey red soil, and 1 foot in sandveld, and the upper bank of the cutting must not be left vertical, but sloped back 3 feet for every foot in depth.

The degree of maintenance required depends to a very large extent on the way in which the land is farmed. *Contour ridges alone are not enough.* Contour farming must be practised, and if this is properly done as explained later, and the land put in good heart, the run-off is greatly reduced, and the ridges never overtaxed.

FIG. 38

WIDENING OF STANDARD RIDGE (FIG. 17 A)

IMPORTANT :- Work shown at "B" and "C" must not be unduly POSTPONED



NOTE :- RIDGE NEEDS NO FUTURE WIDENING. PLOUGH AS SHOWN IN FIG. 35.

If contour farming is practised, and ridges such as fig. 17 (a) and (b) are built, the work of maintenance can be reduced to a part of the ploughing programme. Fig. 38 (a) shows a ridge after 2 or 3 years of ploughing and silting has slightly raised the level of the trough. The plough has been entered close to the side slopes so as to push the soil against them as much as possible. When this stage has been reached, maintenance must not be delayed, as the reduced size of trough is becoming dangerous. A ditcher can be used to give the effect shown in fig. 38 (b) and a plough to re-level the trough and make up the ridge to the outline shown in fig. 38 (c). The ridge then needs no subsequent enlargement to enable it to be planted over, and on flattish to average slopes it can be maintained by ploughing only, as described later.

A suitable practice is to plant a green-crop the season after the widening, and on slopes less than 1 in 30 to plough over the ridges when turning it in (to avoid undue turning on the land). There is little risk in this, as a wide ridge suffers little damage from the plough (except that closing-furrows must be made up) and a smaller run-off can be expected from a green-cropped land. The ridges should be made up before the next season. The plough alone will be sufficient on flat slopes, but a ditcher is necessary on steeper ones.

Though a little widening of the ridges is possible on steep lands, they cannot be ploughed *over*, but can be worked *along* with lighter implements. Maintenance must be done with the ditcher.

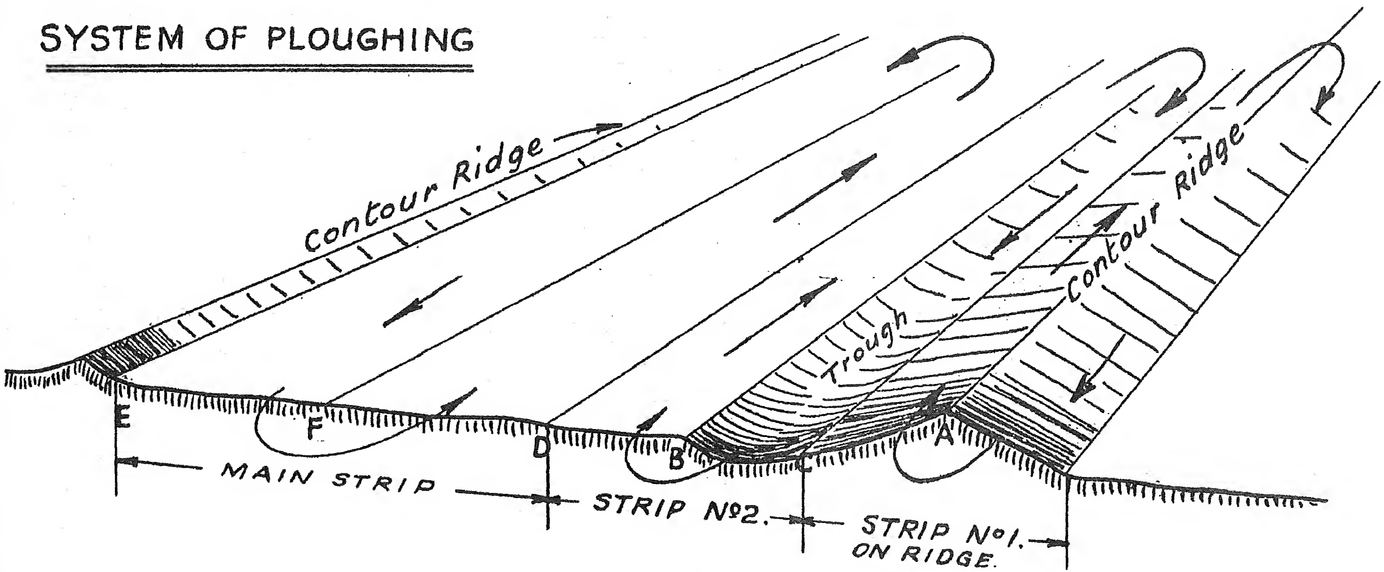
Maintenance should supplement good farming with the object, which can easily be achieved, of making the ridges broad and safe and permanent features of the land. The ridges should eventually be called upon to receive very little silt and only an occasional surplus of water. The correct cultural methods to achieve these results are discussed below.

FARMING OF CONTOUR-RIDGED LAND.

Ploughing should always be done on the contour, except on very flat lands where it is permissible occasionally to plough across the ridges if they are made wide enough.

FIG. 37.

SYSTEM OF PLOUGHING



The extra time taken to plough a contour-ridged land is very small, except on steep slopes and acute curves, and in such cases the absence of gullies often more than compensates for the inconvenience, apart from the fact that without ridges there might be no land to plough.

On steep lands or where the ridges are narrow it is not possible to plough across the ridges, and a difficulty arises from the fact that the ridges are seldom parallel, and wedge-shaped pieces of land are left unploughed. To avoid excessive turning and trampling on the land it is best to plough these pieces separately with a single-furrow or reversible plough.

Another difficulty that arises sooner or later is that, through the ploughs always being entered in the same furrow, the finishing and opening furrows eventually become hollows and banks. When once the ridges have been sufficiently widened by ploughing against them it is advisable to change the system of striking out. Even before this time it may be as well to alter the position of the central furrow. This can be done by ploughing the land between the ridges in two strips instead of one, and altering the widths of the two strips from year to year.

Fig. 37 shows a system of ploughing which will not only achieve this object but will also perform the maintenance of the ridge (on flat lands) and trough.

The plough is entered on the ridge with the front wheel on the crest (A) and ploughs the side-slopes, throwing the soil inwards. This covers "strip No. 1," which, needless to say, must be omitted on narrow ridges and on steep lands.

Strip No. 2 is next ploughed, striking out the opening furrow at B at an even distance from the ridge. This distance should be altered every year. Ploughing by back-furrowing (throwing inwards) is continued until it reaches strip No. 1, thereby widening and deepening the trough.

Strips Nos. 1 and 2, it will be noted, are ploughed with a right-handed turn, and to avoid overturning the plough a "figure of eight" turn should be made.

Strip No. 3 is then ploughed in the ordinary way. The position of the finishing furrow F varies owing to the yearly alteration of the width of strip No. 2.

This system of ploughing may be alternated with other methods, as thought advisable. For instance, the plough may be entered in the old finishing furrow and the whole land back-furrowed, thereby filling the central hollow and pushing the soil *away* from the ridges.

If the land has been ploughed in two strips, the two finishing furrows may be closed by ploughing them at the same time, the forward trip along one and the return trip along the other, and throwing in one direction only, which almost closes them and avoids undue turning and trampling.

On shallow soil or tobacco lands it is most important to keep the depth of the soil the same throughout the strip between the ridges. The formation of a shallow patch in the centre can be overcome by variations of the methods outlined above.

A far more serious problem is the gradual conversion of ridges into level terraces by the exclusive use of reversible ploughs throwing downwards, which denudes the upper part of the land and piles the soil against the ridge. It would be physically impossible to even out the soil once this had happened. An even depth of soil can be maintained by back-furrowing in alternate years with an ordinary plough, and throwing uphill as often as possible with the reversible plough. The latter has many uses in farming contour-ridged land, but should not be used exclusively throwing downhill.

Once the ridge and trough have been made adequate they should not be increased in size but only maintained by the various methods when necessary. An unduly large bank is a waste of good soil, though this is not a common fault.

No hard-and-fast rule can be laid down. Each farmer must use his own discretion.

Ploughing "Headlands."—The turning of ploughs in the land without lifting them produces a hollow just inside the land and a bank at the edge. The hollow is often a serious cause of erosion. It is good practice to plough the headland up and down the slope in such a way as to work the bank into the hollow and completely fill it. The only hollow left is the small closing furrow which is in the hard ground outside the

land. The most useful ploughs for the purpose are single-furrow and reversible ploughs. If they do not completely fill the hollow a land-leveller will do so.

As far as possible the formation of a hollow at the head-land should be avoided by continuing the straight furrow into the veld, and turning to enter the new furrow with the plough lifted right out. In preference to ploughing round the head-lands, where there is not enough room to turn outside, they should be ploughed as a separate strip, throwing in opposite directions each year.

Humus and Good Ploughing.—Two of the most vital factors in erosion control are high humus content and good ploughing. Erosion proceeds far more rapidly on impoverished land which has been poorly ploughed, and such a land may require twice as many ridges as one in good heart. It also appears that land originally deep and fertile erodes very rapidly when depleted of humus, probably due to over-cropping and neglect.

Conversely, however, humus and good ploughing, with careful avoidance of trampling and packing will assist rain-water to penetrate where it falls *and where it is wanted*. The function of contour ridges is to prevent surplus water causing erosion, and to give it a further chance of being absorbed. Their action in conserving water is a secondary one. Water should be conserved to the maximum extent over the *whole* of the land, and this can best be done by good farming methods, such as rotations, fertilising, green-cropping, manuring, deep ploughing, avoidance of puddling or packing the soil, etc.

Planting Contour-Ridged Lands. — When done by machine, the planter should start along and just *below* a ridge, and succeeding rows should follow this one. The short rows will therefore end at the trough of the ridge below, so that proper drainage is obtained, and the oxen can turn where plants are least likely to grow. If the rows are made parallel to the *lower* ridge, the short rows will be made at the upper part of the land, and the concentration of water will break through the rows. The correct method is most important when shovel-tined cultivators are used.

On eroded land the use of ridging ploughs on the contour is certain to result in serious concentration of water in the gullies. This is a grave problem on tobacco lands, and it is advisable to make "hills" or to "break" the plant ridges on all steepish newly-protected eroded lands. On flattish land, when gullied, the tobacco ridges may well be made at an angle to the contour ridges, and even at right angles.

Planting on Ridges.—Crops on a really wide ridge do not suffer from drought and, as a rule, are better than elsewhere. Narrow ridges on steep slopes (fig. 17 c) should be planted to sunflowers or sunnhemp for seed. Very narrow ridges, as fig. 17 d, cannot be planted, usually grow weeds, and are damaged by rats and rat-hunters.

It is not possible to machine-plant crops on new ridges, except on very gentle slopes. Hand-planting, however, is rapid. Three to five boys are spaced along the ridge and travel along it, making holes a hoe-handle's length apart.

If only for the sake of keeping down pests, it pays to plant all ridges. On tobacco lands a tall crop on the ridges acts as a wind-break.

Strip-Cropping.—Owing to the low cost of constructing permanent protection works, strip-cropping can only be recommended as an emergency measure, or in conjunction with contour ridges.

The object of strip-cropping is to check the rush of surface water, filter out the silt which it carries, and increase the absorption of water.

The run-off and erosion on a land carrying such clean cultivated crops as (a) maize, cotton, tobacco and sunflowers are much greater than for low-growing, running, or dense crops such as (b) Rhodes grass, thick-sown sunnhemp, wintersome, dolichos-bifloris, rapoko, native beans, cereals, lucerne, etc. By alternating strips, on the contour, of (b) crops with (a) crops, serious erosion is checked.

VARIOUS METHODS OF STRIP-CROPPING.

(1) *Strip Interplanting, or "Buffer" Strips.*—After contour-ridging a badly-eroded, badly-farmed land, and to

prevent excessive soil movement during the years that the land is being re-conditioned, strips of (b) crops can be planted at intervals of about twenty rows. At every gully a small brushwood check should be made, and semi-permanent (b) crops should be planted in the silt. This method will give the quickest results in smoothing a badly-gullied land.

(2) *Strip-planting the Line of a Contour-ridge* is useful when for any reason it is not possible to build the ridge at once. The strip should be 5 to 7 yards wide, and all gullies should be blocked as under (1) above.

(3) *Strip-farming* consists of wider strips of alternating (a) and (b) crops, planted on the contour, roughly pegged, but is not intended for permanent protection, and should be replaced by contour-ridges as soon as possible.

(4) *Permanent system* of strip-cropping between wide-spaced contour ridges on steep slopes can be practised by modifications of the three methods above. For instance, hay crops and tobacco could be alternated, the hay being planted on the upper half of one strip and tobacco on the lower half, and the opposite arrangement for the next strip below the contour ridge.

(5) *"Filling" Strips.*—This is a useful way of evening the distance between contour ridges. The main crop is planted just below and along a ridge, and the rows are continued half-way down the strip. A strip-crop is then planted, and if a grass, can be used as a roadway for reaping tobacco, etc. The main crop is then continued in parallel rows almost down to the next contour ridge, when the remaining area is planted to a (b) crop, thus avoiding short rows and holding up silt. This strip-crop can be a permanent one.

(6) *Permanent Hedges in Veld* should be planted on the contour, and may consist of good covering grasses, and rows of aloes, briar roses, Napier grass, Vi-Vi, etc. The subject is fully described in Departmental Bulletin No. 1,016, "Natural Protection from Soil Erosion."

(7) *On New Lands.*—It is often impossible to contour-ridge a land the same year that it is cleared, and there is a common idea that no damage will be done for two or three

years. The best of the soil is the first to go, however, especially if the land is cross-ploughed. The finishing furrows should be approximately on the contour, and should not be completely closed. This narrow strip should be left unploughed, and not damaged by cross-ploughing.

(8) *Timber Breaks.*—It is a good practice on tobacco farms to leave contour strips of virgin timber about 10 yards wide every 50 to 100 yards. These strips act as wind-breaks, and reduce erosion and run-off, but should be supplemented by drains in the strips.

Provided the slope is not too steep, and the land is returned to new grass after two tobacco crops, the system is satisfactory.

(9) *Establishment of Pastures in Vleis.*—To prevent erosion while the grass is establishing itself the land should be protected by low contour ridges of the type made with a disc-plough only, and the ridges first established to paspalum, etc. The strips between ridges should then be planted to grass, and on steep or badly-eroded land this planting should be alternated with belts of sunnhemp, as explained in Bulletin No. 1,016.

Spreading Storm-water.—Pastures can be greatly improved if surplus storm-water, such as that discharged from contour ridges, roads or storm-drains, or gullies, can be distributed over them by systems of contour banks which encourage the water to penetrate.

Several methods can be employed. There is the straight-forward system of contour ridges, built low and broad so that mowing-machines can work over them.

A more elaborate series of ridges is required to collect and spread the water from drains or gullies. In the latter case an earth dam, preferably with a good storage capacity, should be built with a full-sized spillway at one end, and the other end of the dam should be continued in the form of a particularly large contour ridge for some distance. The discharge at this point is spread over the pasture by a series of other ridges, short and quite level so that they discharge at both ends and pass the water on to lower ridges spilling in different

directions. The water is thereby spread over a large area in small volumes, and is eventually returned to the gully or vlei, where another check-dam may be built to lead the water to a further series of ridges. All ridges should be broad and low, and planted to a good binding grass so that they can overflow occasionally without damage. Existing dams can be utilised, and the system laid out accordingly. Each scheme requires a different lay-out to take advantage of local conditions, and engineering advice should be obtained before undertaking it.

Very beneficial results can be expected from a scheme of this sort which, if properly carried out, should provide not only excellent late grazing but also an improved water supply in the paddock. Moreover, the water from storm-drains, instead of being wasted and causing damage, is put to valuable use and retained on the farm. Water from road drains, led through grass to a small dam will provide water for cattle early in the season, before general run-off has taken place.

Grass Rotation.—The practice of alternating crops with pasture "leys" every few years deserves to be adopted. Instead of leaving lands to fallow, they should be planted to a pasture grass, such as Rhodes grass, which would give excellent grazing and hay. Many farms are short of grazing, since what is usually left for this purpose is poor, rocky, trampled and burnt.

A land planted to grass for 3 or 4 years and then returned to crop production will have given valuable grazing, and received great benefits, provided that it has been fertilised, and properly grazed or mown. The fertiliser, manure, humus and fibre in the soil when it is re-ploughed are valuable plant foods, and put the land in better heart to resist erosion. In fact, there is no reason why the land should not be even better than it was when first cleared, since the grass-roots may have loosened the plough-pan, and it will contain a higher proportion of humus and fibre after a well-grown grass crop than was present in the original veld.

In some cases the grass can be established by broadcasting the seed and light harrowing the surface. Common Paspalum (*dilatatum*) and the native paspalum (*scorbulatum*) have been established in this way, though the process is slow. Both these

grasses seed freely and can choke out less desirable grasses if mowing and grazing is regulated to this end.

The land should be contour-ridged with the object of conserving as much water as possible, so that several beneficial results are obtained from the one process.

Legal Considerations.—There is an obligation on all persons dealing with storm-water to do so in a proper manner, without detriment to other parties. This obligation rests not only on on farmers but also on such bodies as Road Councils, the Roads Department, Railways, etc. The legal position at present is not well defined, but the possibility of widening the Water Act to embrace disputes over storm-water is under consideration. The Roads and Road Traffic Act contains clauses defining the reciprocal rights and obligations of road authorities and occupiers of land in so far as drainage on to and from roads is concerned. The principle underlying all matters of this sort is that water should be returned to its nearest natural drainage channel without harmful concentration before leaving the property concerned, and free from objectionable silt.

In practice it is impossible to lay down hard and fast rules, as each case must be treated on its merits, and for this reason it is all the more important that matters of this sort should be treated in a true spirit of co-operation. To put it no higher, A may find that though in one case he has an advantage over B, in another he may be the victim of similar action by C. An attitude of "give and take" will be to the ultimate advantage of *all* concerned, and it will nearly always enable the necessary work to be done at the least possible expense.

The Raising of Forest Seedlings and Transplants on the Farm.

By E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.

The following article on nursery practice is intended to meet the requirements of the farmer and general tree planter who find it more suitable, for reasons of economy in transport and expense, to raise their own transplants than to purchase stock raised by nurserymen. The procedure advocated refers mainly to the commoner trees planted in this Colony, *viz.*, eucalypts, pines, cypresses, callitris, cedrela and jacaranda.

Source of Seed.—Seed may be purchased from Government Forest Nurseries as quoted in Departmental price lists, or from nurserymen of standing. If, however, trees of the species it is desired to establish are thriving in the locality, it may be cheaper to collect seed from them. Only well formed mother trees should be selected, and, *ceteris paribus*, trees bearing excessively heavy crops of seed should be avoided, as their condition may indicate ill-health or non-suitability to the locality.

Branchlets carrying ripe seed vessels or cones should be picked and piled on a sheet of canvas or some large open vessel, and placed in the sun in a spot protected from wind. In the course of two days to a fortnight the vessels will open and free the seed. Shaking and turning over the pile will accelerate liberation. The seed is finally collected from the threshing floor, and, if not to be sown immediately, should be stored in a cool, dry place. It is obvious that single seeded fruits will not need this treatment.

Quantity of Seed for Planting Requirements.—It is wise to sow sufficient seed to produce more plants than the ultimate number per acre required for planting. To ascertain the approximate number of plants required per acre for any

planting distance, in the more usual square-planting, the rule is to divide the number 43,560 by the square of the planting distance, thus:—

$$\text{Planting distance} = 6 \text{ feet by } 6 \text{ feet}$$

$$\text{Number of plants required} = \frac{43{,}560}{6 \times 6} = \frac{43{,}560}{36}$$

$$= 1{,}210 \text{ plants}$$

In order to produce at least 1,210 plants, the following quantity of seed should be sown:—

Eucalyptus saligna, E. botryoides, E. rostrata, E. tereticornis, E. punctata, E. maideni, E. microcorys,	1 oz.
Pinus insignis, Cupressus torulosa, Cupressus lusitanica, Cupressus arizonica, Callitris calcarata, C. robusta, Cedrela toona	3 ozs.
Pinus longifolia	4-5 ozs.

Time of Sowing.—Eucalypt seed may be sown during August to mid-November for planting out during the same rainy season.

Cedrela toona should be sown fresh immediately after ripening in December for planting out during the same rainy season.

Seed of pines, cypresses and callitris may be sown during February, March and April for planting out in the following rainy season.

Preparation of Seed Beds.—The nursery should be in a locality near permanent water, protected from winds and carrying a well drained soil. Due regard should be paid to the distance of the planting area and, to facilitate supervision, the homestead.

The soil should be well broken up and reduced to a fine tilth. No sticks, stones or clods should be left in the upper 3 inches of soil. Sterilising by burning and fertilising is not ordinarily necessary. A light sandy loam is suitable for a temporary nursery. For a permanent nursery a mixture of

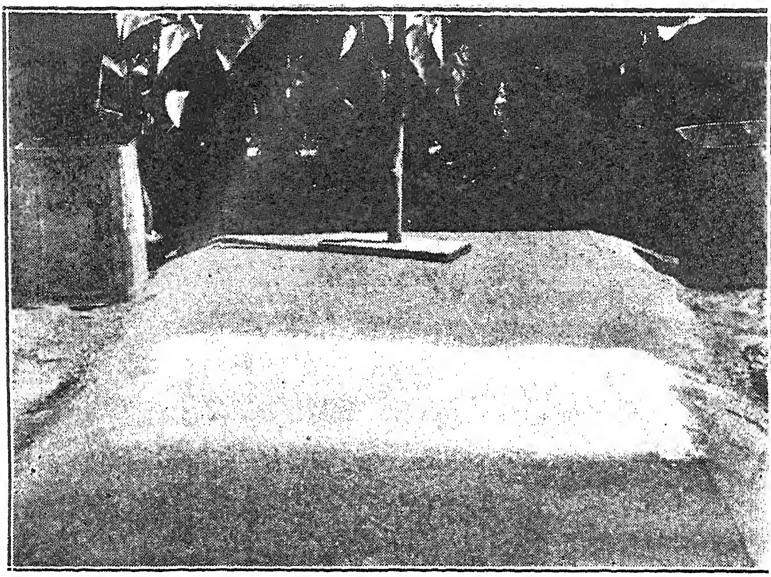


Plate No. 1.—Method of making seed beds. Note board for levelling the beds. Seed sown on bed in foreground; seeds covered with fine sand beyond; part of bed beyond not sown.

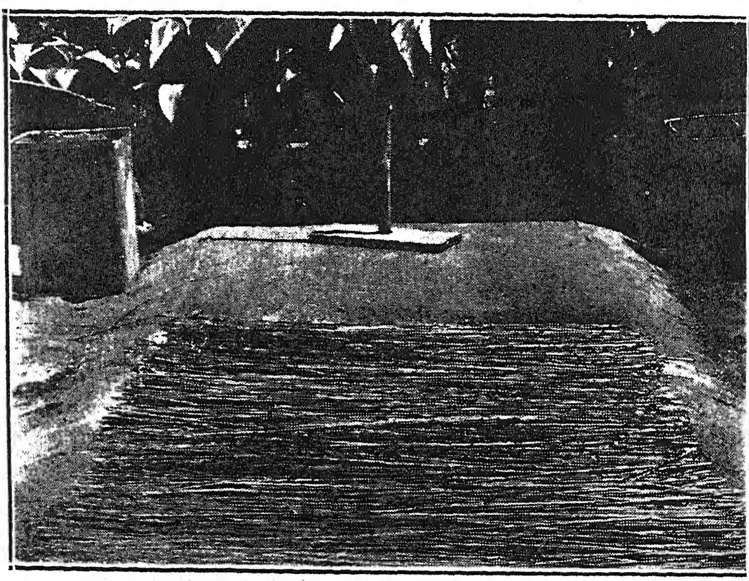


Plate No. 2.—Method of covering beds with grass. Well combed grass should be used.

heavier soil and leaf mould may be added to the end that the soil will be both friable and retentive of moisture.

When the soil has been well tilled, beds 3 ft. 6 ins. in width, of any suitable length, and about 20 inches apart, should be marked off, levelled and pressed down to ensure a smooth surface. Plate 1 shows a suitable implement to smooth the suface of the beds. It consists of a board nailed to a handle.

As an alternative to the use of seed beds, half petrol tins, filled with soil as already indicated, may be utilised. They have the advantage of being easily transportable to the pricking-out site, and, when uneven germination is experienced, they enable the grower to work systematically with the seedlings as they reach the pricking-out stage. Direct planting is not ordinarily advisable from seed tins.

Sowing the Seed.—Seed may be sown broadcast, the density of sowing being dependent on the desired subsequent treatment. If it is intended to prick out seedlings into tins or trays, 3 to 4 ozs. of eucalypt seed and 6 to 8 ozs. of conifer seed may be sown to the square yard. The easiest way to gauge the density of sowing is to aim at a condition where slightly more seed is visible on the seed bed than soil.

If the seedlings are to be planted out direct from the seed beds a much lighter sowing—about 1 oz. to every 10 to 20 sq. yds.—should be carried out, dependent on the size of the seed.

For planting out direct, line sowing may also be adopted. Seed in sprinkled along the surface of the bed, or dibbled-in, in the case of large seeds, in lines about 6 inches apart. This system naturally requires more space than broadcast sowing, but it has the advantage that thinning, weeding and root pruning operations are facilitated.

Broadcast sowing by hand gives good results in most instances. With very fine seed it may be sometimes advisable to mix the seed with fine sand to ensure even distribution. The sowing of eucalypt seed through a watering can is neither necessary nor advisable. When the seed has been sown it should be covered with a layer—the depth equal to the breadth of the seed—of sand or other soil which has previously been

put through a sieve of fine mesh. The beds, or seed tins, should now be covered with well combed grass of sufficient thickness so that the soil cannot be seen. See Plate 2. As the grass may come in direct contact with the seed it is important to have it well cleaned, otherwise "white ants" may be attracted to the beds. A good watering should now be given to the seeds through the grass. Hessian may be used instead of grass, but, especially with eucalypts, it renders the operation of gradually lessening the shade more difficult.

Care of Seed Beds.—Watering of the beds should be carried out once or twice daily. The weather conditions prevalent over the germination period will indicate the frequency of watering desirable. Success lies in keeping the soil moist, though not sodden. Germination should take place within six to fourteen days in the case of eucalypts and cedrela and fourteen to thirty days or more for pines, cypresses and other conifers.

When germination is complete most of the grass should be removed, a very light covering being left for a few days to enable the young seedlings to harden off. All the grass should then be removed. If the grass is left on too long the seedlings will tend to spindle and will be useless for pricking out. This operation of removing the shade gradually is very important, especially with eucalypts, which are extremely tender in early youth.

In the case of beds sown for plants to be planted out direct in the field, the seedlings should be thinned out where they are too dense, leaving about 80 seedlings to the square foot. Thinning should be done by cutting out undesirable plants. Pulling is bad practice, as it damages the roots of the plants which are to remain. Weeding should be carried out whenever necessary, and waterings must also be frequent.

With eucalypts, when the young plants have from six to ten leaves, root pruning should be resorted to at intervals of about three weeks to encourage the formation of a fibrous root system. The operation is carried out by inserting a long-bladed knife or sharp spade 4 to 5 inches below the surface. With other species root prunning should start when the plants are $1\frac{1}{2}$ to 2 inches high. Line sowings are more easily treated by this operation. See Plate 3.

Inoculating Soils for Pine Seedlings.—It is necessary at this stage to draw attention to a soil requirement which appears to be essential to healthy pine growth in various parts of the Colony. This requirement is a fungus which, apparently acting in association with the roots of pines, enables them to carry out their normal function. Without this fungus assistance the young pines tend to remain stunted and to bear an unthrifty, sickly yellow appearance. It would appear that the soils carrying thriving pine plantations are well infected with the fungus. When soil from such plantations is introduced to new nurseries, healthy pine seedlings result. This procedure is now advocated wherever pines are to be raised. It is well to inoculate the soil both in the seed and transplant beds or tins. A handful to the square foot would suffice, and should be forked or raked into the new soil.

Pricking Out.—The primary object of all pricking out is to ensure that each plant shall have a well-developed root system. Where seedlings are pricked out into tins or trays, the resulting transplants are finally planted out with a ball of earth surrounding each root system. In inexperienced hands and in a climate where droughts are frequent, balled plants are liable to less risks in planting out and are more capable of readily establishing themselves than open-rooted plants, which are used when seedlings have been pricked out into beds. The latter method is obviously cheaper, although it is in turn more expensive than the use of plants set out direct from seed beds.

Pricking Out into Tins or Trays.—Petrol tins cut longitudinally in half or wooden boxes approximating them in size are most commonly used for the reception of pricked out plants. A few holes to facilitate drainage are punched in the bottoms of the tins, which are then filled almost to the top with, preferably, previously prepared soil. Such prepared soil might consist of three parts heavy loam, three parts sand and one part well rotted vegetable matter. This should be well mixed, sieved if necessary, watered and thrown into a heap until required. The object is to obtain a soil which will bind slightly and not give off moisture too rapidly.

The soil in the tins is then watered, and holes, equidistant and 25 to 30 per tin, are made either with a pointed stick alone or with the assistance of a dibbling board, of a size

to fit the tin, with holes about half an inch in diameter spaced as required. A dibbling stick is inserted through these holes into the soil. The tins are now ready for the pricked out seedlings.

The operation of pricking out is best carried out in the shade. It is well previously to construct a simple shade house made of poles, with a loose roof of branches carrying sufficient foliage to allow plenty of light within the structure, at the same time appreciably lessening the intensity of the sun's rays. A portion of the shed should be fitted up with a rough table and have complete shade overhead. The tins containing the soil are placed on the table ready for the seedlings. Seedlings are ready for pricking out when they are about 1½ inches high, and in the case of eucalypts, when they have two to three pairs of leaves. With a spade a clod of earth carrying sufficient seedlings to fill two or three tins is dug out and carried quickly to the table in the pricking out shed. Great care should be taken to expose the roots as little as possible to the air. With a pointed dibbling stick the seedlings are removed from the clod of earth one by one and quickly examined. If the tap root is too long and obviously out of proportion to the rest of the plant, it should be nipped off with the thumb and forefinger, leaving a root which is half as long again as the stem. If the tap root is badly bent, or the seedling otherwise ill-shaped or unhealthy, the plant should be thrown away. The plant, having been examined and found suitable, is inserted into the prepared hole, and the soil is pressed against it from the side with the dibbling stick in such a manner that the root is not bent and that there is no air pocket at the base of the hole. The seedling should be inserted no deeper than it stood in the nursery bed, *i.e.*, at the collar. A seedling pricked out with a bent tap root, or with the collar deep in the soil, starts with a handicap from which it will never recover. It simply means waste of money, labour, time and a gap in the plantation.

As each tin is filled with plants it is placed in the partial shade of the other part of the shed and watered through a fine rose. Subsequent waterings need only be given when the soil

shows signs of drying out. After a week or ten days in the partial shade the tins are placed out in the open sunlight, where the plants are allowed to harden off.

Pricking Out into Beds.—If it is desired to use open-rooted plants, pricking out into transplant beds will ensure better individual root systems than are obtainable with seedlings set out direct from seed beds. The same treatment and method of preparing the beds are followed as already described. Holes are prepared in the beds with a dibbling stick through a dibbling board in which holes have been bored with an espacement of, say, 2 inches by 3 inches. Tins or clods of earth containing seedlings are carried to the beds, where pricking out is done as before. Temporary and partial shade may be erected over the beds, and may be maintained during the hardening-off process.

Care of Plants Prior to Planting Out.—Plants which have been pricked out into tins or beds, or which have been left in the nursery beds for direct planting, should be watered frequently; dead plants should be replaced and weeding carried out. If planting rains are long delayed and the young plants show a tendency to too rapid growth, this growth should be checked by watering very sparingly. The plants should in effect be made to struggle. The leaves, if the plants are given sufficiently short rations of water, will take on a bluish or brownish colour. This need cause no alarm, as hardy plants will result. On the other hand, this will be the sign that a watering must be given soon in order to keep the young plants alive. If the planting of trees contained in tins is held over for any length of time, periodical inspections should be made by turning over the tins and pruning off all the roots which have come through the drainage holes.

Conclusion.—A perusal of the foregoing pages will show that even the least experienced may achieve success in raising trees, *provided adequate care and supervision of the necessary operations are exercised.* Neglect and haphazard methods must inevitably lead to failure and disappointment. In rearing human and other animal juvenile life the most elaborate precautions are taken. Trees, also, are living things, and, though their protests against harsh treatment may be voiceless, they are none the less entitled to consideration.

Successful Witchweed Control.

(Continued.)

BY RHODESIAN FARMERS.

Further reports from Rhodesian farmers on their experiences in the control of witchweed are published. Although they vary in their preferences for certain methods of control, it is clear that all of the writers are satisfied that this parasite can be economically controlled.

REPORT No. 7.

By Mr. E. S. WHITE, Bretten, Concession.

This pest was first brought to my notice about the year 1912 through the *Farmers' Weekly*, and the following year the late Mr. J. A. T. Walters gave a lecture about it at the Hartley Show.

While farming at Makwiro and up to the time I came to this farm at the end of 1918 I had not to my knowledge seen a plant, but during 1919 I discovered that this farm was moderately infested. That same year I set to work to make drains below the hill and contour ridges through the lands to turn off the flood water. The drains above the lands were completed within a few years, but although every year since all available labour has been used to construct new ridges after having repaired, where necessary, the old ones, a certain number still remain to be constructed (after 18 years, hence my suggestion a few years ago that the Government should take a hand in this problem) before all the lands are sufficiently protected.

In this district of rather steep slopes witchweed eradication must go hand in hand with drains and contour ridges; re-infestation, I take it, is principally the result of seed washing in from the veld, other minor causes probably are wind and cattle carrying the seed.

Once a witchweed plant is established in the land and is not checked increase under favourable conditions takes place at an alarmingly rapid rate, and the maize crop on which it is feeding suffers considerably.

If the maize crop has been reduced by this parasite to such an extent that a trap-crop is necessary to continue maize growing, then this method, in my opinion, should be adopted, but it stands to reason that the extent of the acreage to be trapped should not exceed what can be ploughed in at the right time.

It follows that this very important process limits the acreage that can be trapped in one season; so, reasoning in this way, it can be seen how long it would take to practice trap-cropping over the whole of a badly infested farm.

It behoves us then to use every endeavour to prevent gross infestation, the remedy of which only appears to be trap-cropping.

The warning by Mr. Walters to which I have referred was a great help when I was brought face to face with the problem, as he had thoroughly emphasised the seriousness of the pest (this warning has been carried on ever since by other members of the Department of Agriculture and individual farmers).

In addition to drains and ridges which help to prevent the distribution of seed, the pest itself was tackled in the following way. Every year the weeding boys were specially instructed to destroy witchweed plants (this was absolutely necessary as new boys did not realise its harmful effect), then later when weeds and grass were disposed of a boy was placed in charge of a field of mealies (varying in extent according to the infestation) and it was his job to keep it free of witchweed. This needed constant supervision, and if it was found that he was unable to cope with it, then further assistance was brought in, or the acreage reduced.

Had the witchweed menace not been realised a number of natives would have been signed off to reduce expenditure as soon as the mealie lands were clean (this demonstrates the absolute necessity of plenty of hand labour in maize production), in this manner it was kept within bounds.

The pest has not been eradicated. A certain number of plants will always escape detection. But I can safely say that although maize has been grown on this farm for thirty years, the crop this year did not suffer any appreciable harmful effects from this parasite, this leading me to believe that the methods employed have been successful.

On my other farm where the campaign has not been carried on so thoroughly, the pest is present in all lands; it has been attended to, but not so intensively as on this farm. The crop suffers to a certain extent, and where it was getting out of hand I have practised trap-cropping.

My method was as follows: Maize was broadcast thickly on rough ploughed ground and harrowed in towards the end of November. As soon as the plants were from three to four feet high the cattle were turned in and a few days later the ground was ploughed and planted to beans; the following season witchweed was still present, but was considerably reduced in quantity.

This method could be varied with equal or perhaps better results, maize could follow maize, or sunnhemp the same, or any of the crops recommended by the Agricultural Department. I used maize because the seed was available, cheap, and the crop could be grazed, used for ensilage, or hay, and at the same time it effectively germinates witchweed seed; but for good results the most important thing is not to *forget* to plough *all* the land *before* the pest flowers (not long ago I heard a discussion between two farmers about the properties of different trap-crops; one said to the other the particular trap he used was very good, as his land was quite red with the flowers of the witchweed!)

If my remarks are of any use you are quite welcome to use them.

Editorial Note.—It may, perhaps, be pointed out that the area of land which can be trapped in one season with a limited supply of ploughs and oxen can be greatly extended by sowing the trap-crop on a suitable acreage at intervals (of a length adjusted to the capacity of the ploughs) throughout the growing season up to, say, mid-February. This method of sowing a trap is advisable in nearly every case.

REPORT No. 8.

By Capt. H. P. D. Dimmock, Erdington, Mashaba.

The following is a brief account of my experience in controlling witchweed as recommended by the Department of Agriculture.

To be frank, I was sceptical of the danger and thought that the ravages of the pest were exaggerated. I was soon to be disillusioned. The weed spread with great rapidity and the yield of the land fell from 8 bags per acre to less than 2. It was at this point that an agriculturist paid me a visit and examined the position.

Storm Drains.—His first recommendation was to cut a storm drain along the top boundary of the land with a view to preventing the ingress of further seed which would otherwise be washed on to the land from the veld by storm water. This work was immediately put in hand and the result has been not only to prevent further invasion by witchweed, but also to check erosion.

Hand Cultivation.—As regards the effect on subsequent flowering of hoeing witchweed, I have not arrived at any definite conclusions, but do not feel that the value of maize at the present time warrants too much special work of this type which tends to raise the cost of production without appreciably increasing the yield. I favour paying special attention to infested patches at the time of ordinary cultivations of maize by hand and these cultivations can often be timed so as to catch the witchweed before it flowers without resorting to the expense of extra hand cultivation for this purpose.

Trap-cropping.—This is undoubtedly the only really effective method of control, provided that first a storm drain is cut above the land to prevent re-infestation. *The complaint that such a proceeding entails the loss of the use of that land for a season falls to the ground when it is realised that the trap-crop is also a green-manure and apart from the destruction of witchweed greatly enhances the condition and productivity of the land treated.*

As my farm is only a few miles from a Native Reserve I conducted experiments with *white* Kaffir corn, which I was told was reputed to be a good host. The land treated was 20 acres in extent and 10 of these were sown to the tall variety and 10 to the dwarf. I was unable to distinguish any superiority of one type over the other, but both proved to be excellent hosts. Undoubtedly the dwarf variety is easier to plough under, but the tall variety will add more humus to the soil. The seed was broadcast at the rate of 40 lbs. per acre and harrowed in. Unfortunately I tried to get two trap-crops ploughed under in the one season with the result that the ground was too wet to plough the crop in at the best time, and I think that in areas of uncertain rainfall like my own one crop only planted a little late and ploughed under just before the first flowering of the weed will give better results. Nevertheless, the results were surprising, and I estimate that 70 per cent. of the weed was destroyed. The yield of this land had fallen to below 2 bags an acre, and in places *where the infestation was very heavy the maize was unable to make any growth above about 18 inches, but in the season following the trap-cropping this land yielded 7 bags per acre* without the adidtion of artificial fertiliser and despite the fact that the crop in the later stages was heavily attacked by locust and also was reaped prematurely in order to get the bonus for early maize. Witchweed was still in evidence, but not in great quantities as formerly. The rainfall for the season was only 16.62 inches.

The year following (1934-35) this land was put down to cotton and this last season to maize again. Owing to the trap-crop in 1932-33 not being ploughed under at the proper time the land is again infested with witchweed, but not nearly to the same extent as before treatment, the yield being 6 bags per acre. I must mention that planting did not commence until January 10th owing to late rains.

This coming season the land again goes under a trap-crop, and it is hoped to achieve even better results than before.

I see no reason why in localities where witchweed is not very prevalent in the veld it should not be eventually eradicated from lands suitably protected by storm drains.

REPORT No. 9.

By Mr. A. S. Laurie, Somerset, Concession, 31.7.36.

I am a great believer in storm drains and believe they do help to prevent re-infestation by witchweed. I notice too that on my terraced lands, where dongas existed years back, and where even to date you can see the traces of the old dongas left on the lands, that witchweed, if present, is generally heaviest along these depressions. These depressions act as draws so to speak and draw any witchweed growing on the adjacent lands either side.

I cannot help thinking that a source of infestation is that due to whirl winds, also cattle feeding on the lands which pick up the seed and pass it on through their bowels.

Another source of infestation is due to a rotten practice some farmers have of cutting witchweed on the lands after mature seeds have formed on the plants. They put the debris into ordinary sacks and carry it away across the lands. The seed must find its way through the sacking and is thus simply broadcasted over the land. This was being done on my farm; I saw it with my own eyes and the air went blue all round, since when it has ceased. I have seen it done elsewhere too.

As regards hand cultivation, I have always been a great believer in this so long as the weed is cut before seeds form and become mature. In order to reduce the number of cultivations to the minimum wait till the flowers come into good flush, then go for them as you suggested.

I sent you my notes on last year's experiments about a year back; please refer to them. If I remember it took the weed three weeks to come into flower after the first cultivation, the next cultivation had to be done about 18 days later, then about 14 days later and the last cultivation 9 days later.

This year the lands were put down to maize again and there was a very appreciably less amount of the weed met with, in spite of the fact that it was a very much worse year for the weed.

This year no less than seven cultivations had to be done against four last year.

I took you and Mr. Arnold over the lands I experimented with last year and you estimated the crops on two of the plots at 16 to 18 bags in one instance and 22 to 24 in the other. Four years ago these lands were badly effected by the weed.

I will leave it to you to judge for yourself regarding the efficacy of good hand cultivation on witchweed effected lands.

Trap-cropping I have not had much success with. On two occasions I have gone to much trouble putting down catch crops and ploughing them down to time, only to find the following year witchweed comes up and decimates the maize, yet on other lands equally badly infested hand cultivation has given outstandingly good results. One drawback to catch cropping, particularly when such crops as Kaffir corn, amber cane and Sudan grass are used as hosts, is that unless your ploughing is very thorough these crops, having extraordinary vitality, are not destroyed and witchweed grows on their roots and you must follow up by hand cultivation to keep the pest down in spite of having gone to all the trouble of ploughing under the catch crop.

Again, I am of opinion much of the success depends so much on the season, *e.g.*, the season might start off with a long set in of rain, in such a case I believe it reduces the chances of the weed germinating, or delays its germination. If then you plough under the host within two months of its germination what hope is there of destroying the witchweed effectively? The past two seasons have been so entirely different to one another and prove to me that witchweed does best in dry seasons and is comparatively poor in wet seasons.

Now a few words as to costs of witchweed control. I cannot give the costs accurately because it is impossible to arrive at areas, but I should say the average cost per acre of the four cultivations given would come to round about 4.50d. to 5d. per acre. This is dealing with planting done by planter and not check row.

Yours sincerely,

A. S. Laurie.

Editorial Note.—Concerning Mr. Laurie's reference to the lack of time given the trap crop to do its work, it should be

pointed out that the substance which alone causes the germination of witchweed seed is only excreted from young and growing roots, and the two months growth allowed a trap-crop covers the period during which most of the roots are grown. Moreover, other farmers' results are sufficient evidence of the efficacy of trap-cropping, as stated in many of these reports.

REPORT No. 10.

By Mr. H. L. TAYLOR, Isingisi, Mapunga. 30.6.36.

As requested I submit the following details and costs of our witchweed campaign for the 1935-36 seasons. During the 1935 season the work on witchweed started on February 19th, when the following natives were employed for the periods given.

February 19th to February 28th ...	175	boy days.
March 1st to March 8th	408	,,
March 9th to March 16th	220	,,
March 18th to March 30th	251	,,
April 1st to April 19th	518	,,
April 25th to April 30th	210	,,
May 15th to May 18th	127	,,
Total	1,909	,,

Total labour of 63 tickets 19 days at an average wage of 9/10 per ticket	£30	15	9
Boss boy 56 days @ 1/4...	3	14	8
Total cost	£34	10	8

Total acreage cleaned 702, *cost* 11.8*d*. *per acre.*

Total crop 5,120 bags, cost 1.618d. per bag.

The 1935 season was a very favourable one for cultivation, and on February 19th the farm was clean of all weeds.

A small amount of work was done cleaning 12 rows of mealies near the main road, being experimental work, the costs are small and not included.

Season 1936.—The cleaning of witchweed started late owing to the late growth of weeds, a considerable amount of

witchweed was destroyed with the hand cleaning of mealie crops between about February 15th and March 23rd, also during the period March 23rd and March 31st 209 boy days was charged to cleaning in addition to the 148 boy days allocated to witchweed. For this reason comparisons with the 1935 season will be misleading.

The following natives were employed for the periods given on witchweed eradication only.

March 23rd to March 31st	148	boy days.
April 1st to April 15th	502	,,
April 16th to April 30th...	411	,,
May 1st...	52	,,
Total	1,113	,,

Total labour 37 tickets 3 days average wage 10/1 per ticket	£18	14	1
Boss boy 31 days @ 1/4...	2	1	4
Total cost	£20	15	5

Acreage cleaned 760, *or say* 6.6*d. per acre.*

It is my opinion that if hand cleaning is thoroughly done the cost of this work will be considerably reduced in future years.

Yours faithfully,

H. L. Taylor.

Editorial Note.—Mr. Taylor has made here a valuable contribution to our knowledge of the costs of controlling witchweed. When he took over his farm about four years ago, it was suffering from a general, and, over a large portion of it, a severe infestation of the parasite. We can vouch for the fact that during the period he reviews there was still a general, and for the most part, a severe infestation. His careful costings indicate that control of the parasite by hand hoeing, properly supervised, is not an excessive charge against the crop.

DOMESTICATED DUCK AND FLUKE DISEASE.

By F. G. Cawston, M.D., Cantab.

As a means of controlling the number of pond-snails responsible for the spread of Bilharzia disease in Egypt it was suggested that bird-life should be encouraged, for it is a well-known fact that many species of bird feed on fresh-water snails and some, such as *Actophilornis africanus*, visit water-lilies to obtain those species which adhere to the floating leaves.

Wild birds, however, do not seriously affect the number of pond-snails, for they fly from pool to pool and may even introduce other specimens in mud attached to their claws. Domesticated duck are less able to choose their food and readily devour the vast majority of pond-snails in a pool, though it is usually possible to discover a few which have escaped their notice, or for some undiscovered cause have not been eaten.

When breeding a large supply of *Lymnæa natalensis*, Krauss, in connection with the life-cycle of Fasciola under the Streatfield Research Scholarship in 1919 I was unfortunately unable to rescue them from the attack of some domesticated duck which had got loose and rapidly devoured all the examples they could find as well as the ova from a drinking trough.

At that time I had noted a relative absence of pond-snails from pools containing domesticated duck, whilst obtaining numerous examples from neighbouring pools frequented merely by wild birds, and, by persuading the owner to keep domesticated duck on a pool in which many examples of *Lymnæa natalensis*, Krauss, harboured Fasciola larvæ, I noted a relative absence of pond-snails for a period of eighteen months and until the owner left the neighbourhood, taking his ducks with him.

Doubt has recently been expressed of the value of domesticated duck in controlling the menace of fluke-carriers, because investigators in the Far East have found they have no influence on the number of snails serving as carriers of Asiatic *Schistosomasis*. This fact cannot properly be applied to the subject as it concerns this continent, for the African intermediate-hosts are non-operculated species which domesticated duck devour greedily, whilst the Asiatic species possess operculated, stout shells like *Mėlanoides*, which neither wild nor domesticated duck can be persuaded to swallow.

There is, of course, the danger that natives might have their ducks stolen, but it would be interesting if a careful investigation could be made in a badly infected fluke area or where Bilharzia infection is rife to see whether the extensive introduction of domesticated duck which, after all, is a profitable bird, would have a decided influence on the incidence of infection in man and stock and whether the natives could be educated to make more use of these birds in kraal life.

The complete eradication of a species which may be possible by chemical means cannot be effected by natural remedies, but it would seem reasonable to make what use one can of nature's scavengers rather than employ agents which might seriously interfere with other forms of wild-life.

VELD FIRES.

THE "FOREST AND HERBAGE PRESERVATION ACT, 1936."

By E. J. Kelly Edwards, M.A., Dip. For. (Oxon), Chief Forest Officer.

It may be predicted with certainty that during the next few months the all too familiar veld fire will take its annual toll of valuable timber, grazing and wild life, and pave the way for more soil erosion.

It would be wise for all connected with the land to study the provisions of the new "Forest and Herbage Preservation Act, 1936," which was passed during the last session of Parliament, and which can be of the greatest assistance to those who wish to conserve the natural products of the lands.

Veld Burning.—The Act makes it an offence, punishable by severe penalties, for any person without authority to set fire to any vegetation which is not his property, or to kindle any fire which by spreading sets fire to any vegetation which is not his property.

If a person intends to burn growing or standing vegetation on land on which he is authorised to burn, he must give reasonable notice of his intention to all occupiers of adjoining land, at the same time stating as nearly as possible the proposed time of burning.

If a fire, burnt after notice has been given, does spread to adjoining land in spite of the exercise of proper care on the part of the burner, the latter is not liable for the offence of wilfully or negligently setting fire to or allowing a fire to spread to vegetation which is not his property, although he may be liable for damages if such a fire incurs loss on any person aggrieved.

Fireguards.—An owner or occupier of land (A) who wishes to protect it from fires, may call upon adjoining private land holders (B) to contribute one-half of the labour or cost necessary to provide and maintain sufficient fireguards on the

common boundaries. In the event of B's refusal or neglect to contribute, A may construct or maintain the necessary fireguards and is entitled to recover half the cost from B.

A sufficient fireguard must be not less than ten yards wide on either side of the common boundary.

A fireguard, provided it is of the required width, need not necessarily be a strip of cleared land, but may, for instance, consist of belts of fire resisting trees or other trees or plantations so treated as to prove adequate as firebreaks. If there is a dispute as to its sufficiency it shall be referred to the Minister of Agriculture and Lands, whose decision shall be final. To avoid dispute and to obtain added security against fire, it is advisable not to rely on such tree-firebreaks but to consider them as supplementary to a cleared strip, of at least the required width, adjoining the common boundary.

The Act enjoins that every person must properly extinguish any fire kindled by him on the land of another and on roadsides, outspans and vacant land. The practice of reasonable counter-firing is allowed when life, person or property are in danger from an approaching fire.

Trespass.—Entering upon the land of another, without his consent, in pursuit of or with the intention to pursue wild birds or wild animals, or to take honey or bees, or without right entering upon land enclosed by a fence, are offences subject to penalties of fine or imprisonment.

Cutting or Injuring Vegetation.—The Act makes it an offence to cut, remove or destroy trees and other vegetation belonging to another without lawful authority. It is also an offence knowingly to receive vegetation so cut or removed.

The Act allows the Minister to give protection against cutting or destruction to certain trees and plants which may be prescribed from time to time, *e.g.*, by reason of their scarcity or particular value.

The Act further allows the Minister to reserve whole areas in which the vegetation is to be protected or grazing forbidden, such as on stream banks or on hills, or at the head-waters of streams or other sites where soil and water conservation are important.

The reservation of such areas does not apply to private land on which there is a resident European occupier, unless at the request of the owner of private land.

Servant's Liability and Damages.—The Act provides that both or either servant and employer may be prosecuted for contravening any provision of the Act, if the servant is acting under the direction or command of the employer.

Nothing in the Act affects the right of a person to recover damages by civil action for any loss sustained by him.

Finally the Act makes provision that a plaintiff in any action for damages caused by fire from a locomotive may presume negligence on the part of the owner of the locomotive until rebutted by the defendant.

The detailed provisions of the Act read as follows:—

1. This Act may be cited for all purposes as the "Forest and Herbage Preservation Act, 1936."

2. The laws set out in the Schedule to this Act are hereby repealed to the extent therein mentioned.

3. In this Act, unless inconsistent with the context—

"Minister" means the Minister of Agriculture and Lands;

"private land" means any land the ownership of which has by law, grant or title deed become vested in any person other than the Governor, and includes any land held by any person under any agreement whereby such person is entitled to obtain from the Governor title thereto on the fulfilment by him of the conditions prescribed by such agreement;

"vegetation" includes any tree and any part thereof, any bush, shrub, brushwood, undergrowth, grass and any other vegetation.

4. (1) No person shall wilfully or negligently set fire to any vegetation which is not his property unless he has lawful authority so to do.

(2) No person shall wilfully or negligently kindle any fire which by spreading damages or destroys any vegetation which is not his property.

5. (1) Every person, before proceeding to burn growing or standing vegetation upon his own land or upon land on which he is permitted or authorised to burn such vegetation, shall give reasonable notice of his intention to do so to all occupiers of adjoining land. In such notice he shall state as nearly as possible the time at which such burning will take place.

(2) If a fire lawfully kindled after notice given in terms of the preceding sub-section spreads to adjoining land, the fact that such reasonable notice was given—

(*a*) shall to the person who kindled or was responsible for kindling such fire be a sufficient defence to any charge of contravening section *four* in respect thereof, unless it is proved that he wilfully or by the negligence of himself, his servants or agents caused or permitted such fire to spread across his boundaries to such adjoining land; but

(*b*) shall not affect the right of any person aggrieved to recover damages for any loss sustained by him as the result of such fire.

6. (1) Any owner or occupier of land who desires to guard against fires crossing the boundaries thereof may call upon the owner or occupier of any adjoining private land on the boundaries of which sufficient fireguards have not been provided and maintained to contribute one-half of the labour or cost necessary to provide and maintain sufficient fireguards on their common boundaries.

(2) If any person so called upon refuses or neglects to contribute as required by the preceding sub-section, the person so calling upon him may construct or maintain such fireguards and shall be entitled to recover from such first-mentioned person half the necessary cost of such construction or maintenance.

(3) For the purposes of this section a fireguard shall not be sufficient unless it is at least thirty feet wide on each side of the common boundary at all points thereof.

(4) If any fireguard is of the width required by the preceding sub-section, but its sufficiency for the purposes of this section is disputed on the ground that such fireguard is not entirely cleared of vegetation, the dispute shall be referred to the Minister for decision, and his decision thereon shall be final.

7. Any person who is upon the land of another, whether lawfully or not, or upon any road, outspan or vacant land shall carefully and properly extinguish any fire kindled or used by him, and until he has so done shall not go so far from any such fire as to be unable to control it by himself or his servants.

8. Nothing in this Act contained shall be deemed to prohibit any person, when his life, person or property is in danger of loss or injury from an approaching fire, from setting a light to and burning vegetation, in the manner commonly known as counter-firing, in order to prevent such loss or injury;

Provided that he shall take reasonable care that a fire so kindled does not spread beyond the limits necessary to secure him from such loss or injury.

9. No person shall—

(*a*) knowingly enter upon the land of another in pursuit of or with the intention of pursuing any kind of wild bird or wild animal; or

(*b*) take or remove honey or bees from the land of another;

without the consent of the owner, lessee or occupier of such land.

10. Except in the exercise of any right no person shall enter or be upon any land which is enclosed by a fence except with the consent of the owner or occupier thereof.

11. No person shall, without lawful authority so to do, maliciously cut down, fell, remove, injure or destroy any vegetation which is not his property;

Provided that the provisions of this section shall not apply to any native inhabitant of a native reserve in respect of vegetation growing in such native reserve.

12. (1) If he deems it necessary for the maintenance of water supplies, for the conservation of soil, for the protection of roads or other lines of communication, or generally in the public interest, the Minister may, notwithstanding the provisions of any other law, from time to time make regulations, not inconsistent with this Act—

(*a*) prescribing and altering for the whole or any part of the Colony a list of trees and plants which shall not be cut, felled, removed, injured or destroyed save with the special permission in writing of the Minister and on such terms and conditions as may be prescribed by the regulations; and

(*b*) defining and altering areas in the whole or any part of the Colony wherein it shall not be lawful to graze or depasture cattle or other domestic animals, or to cut, fell, remove, injure or destroy any vegetation whatsoever.

(2) The provisions of any regulations made under paragraph (*b*) of the preceding sub-section shall not apply to private land on which there is a resident European occupier, unless, at the request of the owner of such private land, the provisions have been applied to his land by the Minister by notice in the *Gazette*. For the purposes of this sub-section, "occupier" means the person who has for the time being the legal right of occupying such land.

13. (1) Any person who by act or omission contravenes any provision of this Act or of any regulation made and in force under this Act shall be guilty of an offence.

(2) Any person who receives any vegetation, knowing at the time of such receipt that it has been cut, felled or

removed in contravention of section *eleven* or of any regulation made and in force under this Act shall be guilty of an offence.

14. The penalties for offences against this Act shall be as follows:—

(*a*) For a contravention of section *four*, section *eleven*, or any regulation made and in force under section *twelve*, or for an offence in terms of sub-section (2) of section *thirteen*, a fine not exceeding one hundred pounds, or, in default of payment, imprisonment for a period not exceeding one year, or corporal punishment in any number of lashes or cuts with a cane or rod not exceeding fifteen, or imprisonment for a period not exceeding one year without the option of a fine, or any two of the above-mentioned punishments;

(*b*) for any other offence, a fine not exceeding ten pounds, or, in default of payment, imprisonment for a period not exceeding three months.

15. If any servant when acting under the direction or command of his employer by any act or omission contravenes any of the provisions of this Act, such employer and such servant may both or either of them be prosecuted, and, if convicted, punished under this Act.

16. All masgistrates' and native commissioners' courts shall have special jurisdiction in respect of persons over whom they have jurisdiction by law to impose on summary trial the maximum punishments provided for in this Act.

17. (1) Nothing in this Act contained shall be deemed to affect the right of any person aggrieved to recover damages by civil action for any loss sustained by him.

(2) In any action for the recovery of damages sustained in consequence of a fire occasioned by a locomotive, it shall not be incumbent upon the plaintiff to prove that such fire was occasioned by negligence of the owner of such locomotive or any of his servants, but such negligence shall be presumed until such presumption has been rebutted by the defendant.

SCHEDULE.

Laws Repealed.

No. and Year of Law.	Subject or Short Title.	Extent to which Repealed.
Proclamation by the Governor of the Colony of Cape of Good Hope, dated 31st December, 1824.	The Boekhoo Plant	The whole.
Act No. 18 of 1859	Forest and Herbage Preservation Act 1859	So much as remains unrepealed.
Act No. 28 of 1888	Forests Act, 1888	The whole.
Ordinance No. 9 of 1913	Herbage Preservation Ordinance, 1913	So much as remains unrepealed.
Act No. 6 of 1928	Herbage Preservation Ordinance, 1913, Amendment Act, 1928	The whole.

Southern Rhodesia Weather Bureau.

JANUARY, 1937.

Pressure and Temperature.—Mean barometric pressure was generally below normal and temperatures slightly above.

Rainfall.—Rainfall was below normal in most areas and averaged 2 inches below over the country.

Weather Features.—The most interesting feature of the pressure maps during the first half of the month was a "low" which formed over the Mozambique Channel on the 5th. A cyclonic centre developed on the following day and moved to the centre of the West Coast of Madagascar on the 7th. From the 8th to 11th it was slowly crossing Madagascar, maintaining a weak circulation. On the 13th there was a redevelopment of the cyclonic centre near Reunion, after which the normal easterly cyclone track was followed. During this period the southerly highs and lows followed their normal courses, but exercised little influence on Southern Rhodesian weather, as the cyclone maintained a fairly steady E. to S.E. current over the country, except on the 7th and 8th, when a trough connecting the equatorial low to the Channel low moved southwards, bringing a moist equatorial current over the country, from which thunder showers resulted. Otherwise weather was fair in the south and fair to showery in the north, as the equatorial current made occasional excursions over the north of the country. From the 15th to the 24th pressure fluctuations were small and gradients generally weak. Thunder conditions prevailed but rain was not plentiful except on the 21st.

On the 25th equatorial air from the north-west invaded the country and a rain period commenced on the 26th and extended well into February.

JANUARY 1937.

Station.	Pressure Millibars, 8.30 a.m.		Temperature in Stevenson Screen °F.								Rel. Hum.	Dew Point	Cloud Amt.	Precipitation.			Altitude (Feet)
			Absolute.		Mean.												
	Mean.	Normal.	Max.	Min.	Max.	Min.	½ Max. Min.	Normal.	Dry Bulb.	Wet Bulb.	%	F.	0-10	Ins.	Normal	No. of Days	
Angus Ranch... ...	...	...	107	64	90.5	70.1	80.3	77.2	79.2	70.4	65	67	...	6.34	5.80	6	...
Beitbridge...	961.1	...	105	64	92.2	72.7	82.4	...	79.1	69.3	62	64	6.5	1.87	2.64	7	1,500
Bindura...	889.0	...	88	61	81.6	65.0	73.3	...	71.6	66.7	78	64	5.8	11.37	7.46	17	3,700
Bulawayo	867.2	867.6	92	56	82.8	61.4	72.1	71.4	70.4	63.4	68	59	6.6	4.04	5.72	7	4,393
Chipinga	889.9	...	89	58	80.7	61.8	71.3	...	72.1	65.9	73	63	4.1	8.24	10.17	10	3,685
Enkeldoorn...	855.4	...	90	53	80.9	60.0	70.5	70.2	70.0	62.9	69	59	5.5	8.18	7.14	9	4,788
Fort Victoria	893.3	893.1	94	56	83.7	61.5	72.6	72.3	73.7	65.6	66	62	5.2	2.66	6.43	9	3,571
Gwaai Siding	901.4	...	97	57	89.7	63.9	76.8	...	75.2	66.8	65	62	5.0	4.23	6.91	10	3,278
Gwanda...	903.7	...	97	58	85.8	65.5	75.6	...	74.7	66.3	66	62	5.4	5.94	5.75	9	3,233
Gwelo	860.1	...	90	55	81.7	60.9	71.3	71.4	69.7	63.4	72	60	4.6	4.43	5.98	11	4,629
Hartley...	883.0	...	88	57	82.2	62.9	72.6	73.3	72.2	66.1	73	63	5.6	3.88	8.13	18	3,879
Inyanga...	834.8	...	83	48	76.4	55.9	66.1	...	67.7	61.0	69	57	4.6	6.44	9.52	12	5,503
Marandellas	835.5	...	83	55	76.4	58.8	67.6	...	66.9	61.6	75	58	6.1	6.21	8.66	14	5,453
Miami	876.4	...	86	60	78.2	63.5	70.8	...	69.5	65.6	82	63	7.9	6.75	9.10	16	4,090
Mount Darwin ...	905.0	...	91	60	83.4	65.4	74.4	..	73.0	68.3	79	66	8.0	5.18	8.34	9	3,179
Mount Nuza	800.0	...	74	48	66.3	53.1	59.7	...	58.7	56.6	89	55	8.2	9.89	14.59	20	6,668
Mtoko	874.9	...	86	60	79.4	63.7	71.4	...	70.5	65.3	76	63	5.8	5.79	8.13	14	4,141
New Year's Gift...	...	...	97	59	87.2	64.1	75.6	...	76.0	67.6	65	63	...	3.29	8.25	10	2,690
Nuanetsi	958.5	...	107	62	94.8	69.8	82.3	...	79.9	69.7	61	64	5.1	3.35	4.26	7	1,581
Plumtree	862.1	...	92	55	82.5	62.7	72.6	...	72.6	63.3	61	58	3.9	3.94	6.30	10	4,549
Que Que	879.5	...	91	57	85.2	63.2	74.2	...	72.6	65.1	67	61	6.1	3.27	6.86	11	3,999
Rusape	860.0	...	89	55	80.2	60.4	70.3	...	68.6	62.9	74	60	5.3	5.00	7 98	10	4,648
Salisbury	854.0	854.5	81	55	80.6	60.1	70.4	69.3	69.8	63.0	69	59	7.3	4.72	7.36	16	4,831
Shabani...	907.5	...	98	59	86.8	66.2	76.5	...	75.2	66.5	65	62	4.8	2.78	6.02	9	3,131
Sinoia	885.8	...	89	60	82.1	64.1	73.1	...	72.5	66.9	75	64	5.7	8.21	8.10	14	3,795
Sipolilo	882.7	...	83	60	78.8	63.3	71.2	...	71.8	66.4	76	64	7.0	7.78	8.85	14	3,876
Stapleford	839.9	...	78	46	73.9	55.5	64.7	...	65.2	61.0	80	58	5.9	9.44	18.77	18	5,304
Umtali...	890.2	890.9	92	57	84.4	62.9	73.6	71.9	72.6	66.3	72	63	6.0	3.86	8.35	11	3,672
Victoria Falls... ...	909.3	...	95	64	89.5	66.6	78.1	...	74.9	68.8	74	66	4.6	1.69	7.54	15	3,009
Wankie	924.1	...	101	67	91.6	70.4	81.0	...	77.6	70 6	72	68	6.1	3.56	6.04	15	2,567

Rainfall in January, 1937, in Hundredths of an Inch. Telegraphic Reports.

rea	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total	N n
1	...	...	...	..	2	...	27	111	2	...	...	...	...	...	3	...	...	...	...	4	19	2	7	1	59	67	22	88	58	10	...	482	5
2	...	...	...	...	...	...	3	77	7	...	...	...	...	...	...	...	...	...	...	...	70	29	1	...	...	38	19	21	60	91	9	425	7
3	...	...	...	...	...	...	...	158	...	7	...	...	...	...	...	...	...	...	...	...	100	26	1	12	...	76	9	21	16	2	293	721	10
4	...	...	...	...	...	2	23	54	3	11	...	...	...	...	4	9	...	...	...	...	35	8	...	3	27	94	18	10	46	184	18	549	6
5	...	...	...	...	...	32	7	47	12	7	5	...	10	...	3	37	2	...	...	...	35	1	4	...	14	17	27	29	5	...	12	306	6
6	...	...	...	...	...	10	21	107	11	...	3	...	...	...	45	18	18	...	6	...	18	11	...	...	29	53	32	55	108	28	23	596	7
7	1	...	2	...	...	...	30	76	9	23	7	...	...	...	4	26	3	...	...	...	18	9	...	...	...	128	40	17	38	80	97	608	9
8	38	1	4	...	...	21	65	80	63	14	...	...	9	1	3	2	12	5	...	13	40	5	...	...	23	65	33	40	22	78	208	845	8
9	37	12	1	3	2	9	40	71	81	14	...	...	...	9	...	4	31	11	...	65	24	1	...	...	21	47	...	31	53	65	97	729	8
10	47	...	...	...	...	87	19	147	65	...	...	...	...	...	...	...	1	...	...	39	33	13	1	...	...	8	11	4	53	20	1	549	8
lean	8	2	...	...	1	13	22	83	21	7	2	..	2	1	7	12	7	2	1	12	32	8	2	1	22	56	22	38	50	52	39	525	7.

Southern Rhodesia Veterinary Report.

DECEMBER, 1936.

AFRICAN COAST FEVER.

Disease was diagnosed on Plot 15A, Matsheumslope, in the Bulawayo Native District.

TUBERCULIN TEST.

Seven cows and two bulls were tested upon importation with negative results.

MALLEIN TEST.

Thirty-six horses and six mules were tested. No reaction.

IMPORTATIONS.

From the Union of South Africa.—Bulls 2, cows and calves 7, horses 22, mules 6, sheep 977.

From United Kingdom.—Horses 2.

From Bechuanaland Protectorate.—Sheep 365.

EXPORTATIONS.

To the Union of South Africa.—Oxen 562, cows 2.

To Portuguese East Africa.—Oxen 27.

EXPORTATIONS.—MISCELLANEOUS.

To the United Kingdom in Cold Storage.—Chilled beef quarters, 4,386; frozen beef quarters, 1,758; frozen boned beef quarters, 987; kidneys, 273 lbs.; tongues, 2,300 lbs.; livers, 10,596 lbs.; hearts, 3,630 lbs.; tails, 2,360 lbs.; skirts, 2,056 lbs.; shanks, 1,325 lbs.

Meat Products.—From Liebig's Factory: Corned beef, 64,620 lbs.; meat extract, 9,323 lbs.; beef powder, 32,105 lbs.; beef fat, 24,000 lbs.; meat meal, 8,000 lbs.; tallow, 170,327 lbs.; bone meal, 38,000 lbs.; tongues, 7,200 lbs.

G. C. HOOPER SHARPE,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-37.

Monthly Report No. 50. January, 1937.

The following districts have reported winged swarms of the Red Locust (*Nomadacris septemfasciata*, Serv.), during the month of January, 1937, namely, Marandellas, Salisbury, Mazoe, Lomagundi, Hartley, Sebungwe, Bulalima-Mangwe and Matobo.

Although no egg-laying was reported during December, hoppers have appeared during the past month in two districts, namely, Lomagundi (in the Zambesi Valley) and Wankie. Both localities are remote and in native occupation only. The necessary steps have been taken for their destruction.

Birds, mainly kites and storks, have been observed following the swarms in great numbers, especially in the northern districts. Infestation with maggots has been recorded in one instance.

Damage to maize has been sustained in several districts.

No reports of egg-laying were received during January, and at the end of the month the position is somewhat uncertain. Some large swarms are still present in the Colony, and it appears possible that egg-laying has occurred unnoticed in certain areas. There is, however, no present prospect of any widespread outbreak of hoppers.

RUPERT W. JACK,
Chief Entomologist.

Southern Rhodesia Government Stand, Brighton and Hove Home Life Exhibition, 20th to 30th January, 1937.

THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.
(Assisted by the Staff of the Agricultural Department).

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Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Publicity.—The frontispiece of this issue shows the Southern Rhodesia stall at the Brighton and Hove Home Life Exhibition held at Brighton during the last ten days of January this year. It had been arranged that the High Commissioner should open this exhibition, but owing to an attack of influenza this duty had to be performed by the Mayor of Brighton. It will be seen that tobacco, as usual, formed the major part of the exhibit, and during the exhibition the retail tobacconists of Brighton arranged special displays of Empire blends. It was ascertained that Empire blends of pipe tobacco and cigarettes have a ready sale in Brighton, and it was the opinion of the tobacconists that the increase in sales was in proportion

to the improvements in the various Empire brands offered for sale. The total attendance at the exhibition was nearly one hundred thousand, and the Rhodesia stall attracted a great deal of public attention and was accorded very favourable publicity in the local papers.

Tung Oil Enquiry.—We are indebted to Mr. F. V. Heron, B.V.Sc., of Dudleigh Estate, Marandellas, for the following helpful reply to the enquiry for information regarding tung oil:—

What is the best time of the year for planting out the seedlings?—September, second choice January to middle of February.

Is it advisable to cut the young trees back? If so, at what age?—Any age when planted during the month of September only.

Is irrigation beneficial?—Yes, only when coming into bloom and then onwards into the rains.

Have any signs of disease been noticed?—Yes. (1) Nematode. (2) A disease not yet diagnosed characterised by (*a*) a circular constriction at ground level, also one and two inches above ground level; (*b*) a black patch on one side of the seedling above ground level one to three inches up from ground. A Curculio (snout) beetle is suspected.

What is considered the most suitable fertiliser for use in (*a*) nurseries, (*b*) plantations?—(*a*) Sulphate of ammonia, 1 lb.; sulphate of potash, 3 lbs. for every thousand seedlings at 3 months old; one application has been found to be sufficient. (*b*) On account of termites kraal manure is not used by the writer, but the following has given very good results:—Chilian guano or saltpetre, 1 part; superphosphate, 3 parts, or sulphate of ammonia, 1 part; sulphate of potash, 3 parts; and superphosphate, 3 parts.

Is anyone in a position to state whether *A. montana* is better suited to our conditions than *A. Fordii*?—I have not planted *A. montana* before, but intend to do so this year when seeds are available. I find *A. Fordii* does well on my soil, a

sandy, pinkish, very acid but well drained soil. Frequent cultivation at the right distance from the tree is necessary to obtain the maximum growth. A light plough is better for this purpose than a cultivator. My lands have a very deep sub-soil of yellowish sandy clay, but there is no doubt that richer soils, if available, would need less fertiliser. The rate of growth varies according to the development of the root system and the extent of the cultivation. Soil conditions are responsible for a poor root development, and trees which appear to stand still on this account very soon respond to improved conditions. I have seen trees twelve months old with a good root system 5 and 6 feet high and others of the same age with a poor root system only 12 inches high. Some of the latter, however, when the soil conditions were improved put on a growth of 3 feet in a couple of months.

A photograph of a few specimens will be sent along later on showing a backward plant before and after treatment, and also the control trees of good growth.

Farming Calendar.—The Farming Calendar, which has been a feature of this *Journal* for some years, has now been re-arranged and revised and the first part appears in this issue. When the whole revised copy has been published it is intended to issue the complete Calendar as a bulletin.

An Appeal to Farmers.—During the last few months we have been fortunate in securing a greater number of contributions to this *Journal* from farmers in the country than usual, and we are sure that such assistance is greatly appreciated by all our readers. Although it has always been stated that such contributions and correspondence are invited, we feel that the heading to our Editorial pages has become so familiar that it is now ignored. Whether this is actually the case or not we do not know, but we should like to express our thanks to all farmers who have assisted up to the present, and to make a special appeal to all our readers to send notes or articles which they think would be of interest to others. If photographs can be sent and they are suitable for illustrations they will

certainly be used. We should like at least one such article in every issue, and if it is desired to publish in any special number it must reach the Editor not later than the 20th of the month before which it is to appear.

Tobacco Fertilisers used in Canada.—The Standing Committee on Tobacco Fertilisers for Ontario met at Simcoe on November 3rd, 1936, to consider the results of experimental work and to formulate fertiliser recommendations for the various types of tobacco grown in Ontario. These recommendations, based on experiments conducted over a period of years by the Dominion Experimental Station, Harrow, and in Norfolk County by the Dominion Experimental Sub-station, Delhi, and the Department of Chemistry, Ontario Agricultural College, Guelph, were adopted by the Committee, as follows:—

Fertilisers for Bright Flue-cured Tobacco.—Results from these experiments point definitely to the use of 2 per cent. nitrogen and at least 8 per cent. potash in fertiliser mixtures. It must be realised that soil type, productivity, and cultural practices are factors which should be considered in choosing a fertiliser.

1. Quantities of Fertilisers and Analyses of Mixtures:—

A.—Use 800 to 1,000 pounds per acre of a 2—10—8 mixture under average conditions. A 2—12—6 mixture may be used to advantage on some of the low-lying soils where slow maturity has been experienced. Likewise, a 2—10—12 mixture may be used to advantage where potash levels in the soil are low. The fertiliser should be applied and thoroughly mixed with the soil a week or ten days before transplanting.

2. Sources of Plant Nutrient Materials:—

A.—Nitrogen:—

(1) Organic Sources.—At least one-quarter of the total nitrogen should be derived from high-grade organic materials of animal or plant origin, such as dried blood and high-grade tankage or soybean meal and cotton seed meal.

(2) Inorganic and Water Soluble Sources.—(*a*) At least one-quarter of the total nitrogen should be derived from nitrate of soda. (*b*) The balance of the nitrogen may be derived from standard water-soluble materials.

B.—Phosphoric Acid:—

(1) Derived from superphosphate or other easily soluble phosphates.

C.—Potash:—

(1) Derived from sulphate of potash and muriate of potash, or a portion from sulphate of potash magnesia or other sources of water-soluble potash. In soils with low potash levels excessive quantities of magnesia tend to accentuate the expression of potash deficiency symptoms.

(2) Care must be taken not to include a larger proportion of muriate of potash than will bring the chlorine above 2 per cent. of the total mixture.

Special Note.—Maintenance of humus and retention of soil moisture are essential for the most effective use of commercial fertilisers. These conditions on tobacco farms may be improved by planting windbreaks and reforesting waste areas. Indiscriminate destruction of existing wood-lots is not only a menace to the tobacco grower but to every resident of South-western Ontario.

Free Issues of Seed Wheat.—Small free issues of a number of varieties of seed wheat are available for farmers who are prepared to grow them under the Department of Agriculture's Co-operative Experiment Scheme. All these varieties have been tested on experiment plots in the Umvuma District and are considered to be worthy of an extended trial. They are intended only for farmers who are desirous of establishing pedigree seed plots under the co-operative scheme. Application should be made to the Agriculturist, Box 387, Salisbury.

Director of Publicity's Annual Report.—The annual report of the Director of Publicity for the year 1936 has now been distributed. It contains a good deal of interesting matter which indicates that Southern Rhodesia is becoming more popular with tourists from year to year. The importance of tourist traffic to South Africa has long been recognised, and means of extending and improving the tourist facilities are fully discussed each year at the annual publicity conference. The last conference met in Johannesburg at the end of September in the Empire Exhibition grounds and was attended by the Director of Publicity of Southern Rhodesia. As is usual at these annual meetings matters under discussion were mainly the domestic concern of the Union. These conferences, however, provide a welcome opportunity of meeting people engaged in publicity work in Union centres, and are therefore of value. Delegates attending the conference numbered 140 and included representatives from Northern Rhodesia and Nyasaland. An invitation was extended to delegates, on behalf of the Government of Southern Rhodesia, to hold their next conference in Southern Rhodesia, and this was unanimously accepted. It has been suggested that a suitable date would be August 10th and 11th, and this has received the approval of the General Manager of the South African Railways, who acts as Chairman of the conference. The venue will be Salisbury.

Cowpea Molasses Silage for Fattening Steers.

By C. A. MURRAY, M.Sc. (Agric.), Senior Animal Husbandy Officer in Charge, Matopo School of Agriculture and Experiment Station.

A. E. ROMYN, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Salisbury.

R. H. FITT, Dipl. Agric., Animal Husbandry Officer, Department of Agriculture, Salisbury.

SUMMARY.

Two feeding trials were carried out to compare the feeding value of cowpea molasses silage and cowpea hay. In both trials 3 lbs. of cowpea molasses silage proved equal in feeding value to 1 lb. of cowpea hay for the fattening of bullocks. The silage was not so palatable as the hay. It was shown that by mixing one-third of green maize cut at the usual ensiling stage with the green cowpeas it was possible to make excellent silage without the use of molasses.

DESCRIPTION OF EXPERIMENT.

Farmers in the Colony are beginning to realise the great importance of suitable protein supplements in the rations of different classes of livestock. Different legumes, such as velvet beans, cowpeas, Kaffir beans and dolichos beans, are easily grown and supply a cheap source of protein on the average farm. Owing, however, to the unfavourable weather conditions which frequently obtain at the time of haymaking, it is very seldom that really good quality legume hay, high in protein, vitamins and mineral matter is obtained on the average farm. Of recent years legume silage has come forward as an alternative feed to legume hay.

Generally, legumes when ensilaged by themselves do not make satisfactory silage. The amount of starch and sugar

in these crops is small and consequently insufficient acids are formed while the silage is maturing to prevent putrifactive organisms from becoming active and, as a result, partial decomposition sets in and an inferior quality silage is produced.

A few years ago German workers found that the addition of sugar in the form of $1\frac{1}{2}$ to 2 per cent. of molasses to legumes at the time of filling the silo ensured the formation of sufficient acid to prevent any serious loss of feed constituents and to ensure the production of high quality silage.

During the past few years this system of making "molasses silage," as it is commonly called, has received extensive publicity in the South African farming Press and in reports from some of the Agricultural Schools. Data on the feeding value of the silage was, however, lacking in many cases.

The present experiment was planned to obtain general information about the preparation of cowpea molasses silage under local conditions and to compare the resultant silage in feeding value and palatability with good quality hay made from the same crop.

The results of two trials carried out at the Rhodes Matopo School of Agriculture and Experiment Station during 1934 and 1935 are recorded in this article.

"New Era" cowpeas were used in these trials. The crop was cut in the early pod stage.

To ensure the formation of good quality legume silage it is advisable that the material should remain cool. The cutting and carting of the green cowpeas was therefore carried out in the early morning. As a matter of fact the wagons usually arrived at the silage pits by 8 a.m., and by 10 a.m. the silage for the day was all in the pits.

The green material was cut into concrete lined pits 12 feet x 12 feet x 14 feet deep. When approximately one ton had been cut into the pit the molasses, diluted with four times it volume of water, was sprinkled over the silage with an ordinary watering can. The material was always well tramped down.

TRIAL No. 1.

This trial was carried out from the 5th October to 16th December, 1934.

Experimental Steers.—Three uniform groups of approximately five year old Grade Shorthorn and Grade Red Poll steers were used. Each group consisted of 14 steers and in the making up of the groups every precaution was taken to ensure that they were similar in respect to age, weight, conformation and breeding. When finished these steers were marketed as chillers for export to the United Kingdom.

Rations Fed.—The three groups of steers received the same concentrate ration which consisted of a mixture of nyouti meal* and Kaffir corn meal with small quantities of bonemeal and salt. The roughage part of the ration was made up as follows:—

Group I. received 7 lbs. cowpea hay per head per day; Group II., 21 lbs. cowpea molasses silage; and Group III., 7 lbs. cowpea hay plus 10 lbs. maize silage. All groups received, in addition, veld hay *ad lib*, which was fed from racks.

A crop of cowpeas which cuts 1 ton of hay per acre should yield approximately 4 tons of silage. On a dry matter basis 3—4 lbs. of cowpea silage should be approximately equal to 1 lb. of cowpea hay if there is no abnormal loss of nutrients in the manufacture of the one product as compared with the other. Hence, 21 lbs. of silage was fed in Group II. in comparison with 7 lbs. of hay in Group I. The maize silage was added to the ration in Group III. so as to test the effect of succulence in the ration. It is not thought that the addition of the nutrients in 10 lbs. of silage would greatly effect the results, as this group consumed less veld hay.

Experimental Results.

It was unfortunately not possible to have the green cowpeas or the silage and other feeds used in Trial 1 analysed. Protein determinations were, however, made in Trial 2. All analyses were carried out by the Division of Chemistry.

*Pennisetum typhoides—also known as munga. Grown extensively by natives as a grain crop.

TABLE I.

Average Growth and Feed Consumption in Groups I., II. and III. in Trial 1.

	Group I.	Group II.	Group III.
Growth—			
Average initial weight per steer, lbs.	999	1,000	993
Average final weight per steer... lbs.	1,163	1,188	1,163
Average total gain per steer ... lbs.	164	188	170
Average number of days fed...	63	63	63
Average daily gain in weight per steer ... ... lbs.	2.6	3.0	2.7
Feed Consumption per Head per day. Roughage—			
Veld Hay ... ... lbs.	11.0	10.6	9.8
Cowpea hay	7.0	—	7.0
Molasses silage ... ... lbs.	—	21.0	—
Maize silage ... ... lbs.	—	—	9.2
Concentrates per head per day.			
Nyouti meal ... ... lbs.	8.6	8.5	8.6
Kaffir corn meal... ... ... lbs.	3.6	3.6	3.6
Bonemeal ... ... lbs.	0.2	0.2	0.2
Salt ... ... lbs.	0.1	0.1	0.1
Total concentrates ... ... lbs.	12.5	12.4	12.5
Feed Consumption per 100 lbs. gain in Live Weight.			
Cowpea hay	268	—	258
Veld Hay	421	353	358
Cowpea molasses silage	—	696	—
Maize silage	—	—	336
Concentrates	475	414	457

TRIAL No. 2.

This trial was a repetition of the previous one and was carried out from the 4th July to the 10th of October, 1935.

Experimental Steers.—Twenty-one uniform Aberdeen Angus x Africander cross-bred steers were divided into three even groups of seven per group. Again due regard was paid to factors such as age, weight and conformation of the steers.

Rations Fed.—As in Trial No. 1 the three groups received the same concentrate ration throughout the experiment. In this case the concentrates consisted of maizemeal with small quanities of bonemeal and salt.

The roughage part of the ration was made upon similar lines to those followed in the previous trial.

The steers in Group I. received 8 lbs. cowpea hay per head per day, Group II. 25 lbs. cowpea silage per head per day, and Group III. 8 lbs. of cowpea silage plus 10 lbs. maize silage per head per day. All groups received veld hay *ad lib* from racks.

Composition of Feeds.—Before the green cowpeas were ensiled a representative sample was taken for analysis. Similar samples were taken afterwards of the molasses silage and the cowpea hay fed to the steers. The crude protein of these samples, calculated to 100 per cent. dry matter, was as follows:—

Green cowpeas, 15.7 per cent.

Cowpea molasses silage, 15.0 per cent.

Cowpea hay, 13.4 per cent.

In this experiment there has been practically no loss of protein between the green crop and the silage, though there was a loss of approximately 2 per cent. of crude protein in the haymaking.

Experimental Results.

TABLE II.

Average Growth and Feed Consumption in Groups I., II. and III., Trial 2.

	Group I.	Group II.	Group III.
Growth.			
Average initial weight per steer, lbs.	863	835	863
Average final weight per steer... lbs.	1,153	1,141	1,170
Average total gain per steer ... lbs.	290	276	307
Average number of days fed...	98	98	98
Average daily gain in weight per steer ... ... lbs.	3.0	2.8	3.1
Average cold dressed weight per steer ... ... lbs.	594	604	617
Average dressing percentage...	51.5	52.9	52.7
Feed Consumption per head per day. Roughage.			
Veld hay ... ... lbs.	11.5	12.1	8.5
Cowpea hay ... ... lbs.	8.0	—	8.0
Molasses silage ... ... lbs.	—	25	—
Maize ... ... lbs.	—	—	10
Concentrates.			
Maize meal per head per day	9.9	9.9	9.9
Bonemeal per head per day	.2	.2	.2
Salt per head per day	.1	.1	.1
Total concentrates per head per day	10.2	10.2	10.2
Feed Consumption per 100 lbs. gain in Live Weight.			
Cowpea hay...	270	—	254
Veld hay...	287	427	274
Cowpea molasses silage	—	884	—
Maize silage	—	—	318
Concentrates	340	361	324

DISCUSSION OF RESULTS OF BOTH TRIALS.

Growth and Fattening.—At the commencement of each trial there was no difference in the average weights of the three groups. During both feeding periods the steers did remarkably well on all three rations, and Groups I., II. and III. gained on the average 2.6, 3.0, 2.7 lbs. and 3.0, 2.8 and 3.1 lbs. per day respectively in the two trials.

The differences between these average daily gains fall well within the limits of experimental error and are therefore probably not due to the rations fed but to the individuality of the steers.

After slaughter the carcases of all the steers were examined very carefully and no differences could be noticed in finish, colour or any other respect in either trial.

From the above, therefore, it can be concluded that for growth and fattening there was no difference between the three rations fed and that they were equally efficient.

The cowpea molasses silage was cleaned up but was never, however, eaten with the relish that cattle usually show for maize silage.

Feed Consumption.—The amount of feed consumed by each group per 100 lbs. gain in liveweight was approximately equal. In Trial 1, Group II., cowpea molasses silage made somewhat more economical gains than the other two groups. In Trial 2, however, the silage group did not do quite as well as the other two groups.

The feed consumption per unit gain in liveweight is considered satisfactory in all groups, and it appears that there was no real difference in this respect between the three rations.

Conclusions.—The following conclusions are drawn from the two trials:—

1. Satisfactory cowpea molasses silage can be made in Matabeleland and there is no abnormal loss of protein in the conversion of the green material into silage.

2. 3 lbs. of cowpea molasses silage will replace 1 lb. of cowpea hay in a mixed ration for fattening bullocks.

3. Cowpea hay is more palatable than cowpea silage, but where climatic conditions are unfavourable for the manufacture of hay, the crop can be turned into silage and utilised without the loss of nutrients which often occurs when legume hay is made under farm conditions.

PRACTICAL CONSIDERATIONS.

Advantages and Disadvantages of Molasses Silage.—Some advantages and disadvantages of a legume molasses silage are probably worth emphasising at this stage. As the cost of the molasses is in many cases one of the disadvantages, some notes have been included on the use of green maize as a substitute for molasses in the making of legume silage.

Advantages.—(1) The making of molasses silage is practically fool-proof.

(2) A smaller loss of nutrients takes place than during the process of haymaking. The losses in haymaking can easily be very large, unless particular care is taken when curing the hay to prevent it from bleaching and to save the leaves, a large proportion of which are usually lost during handling. It seldoms happens that a crop of bean hay is cured without getting one or more showers of rain on it, and should this happen considerable loss of nutrients may take place.

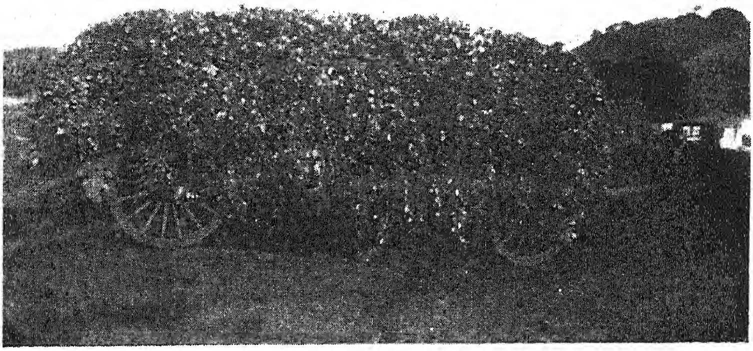
(3) Very much less handling and labour is required in making molasses silage than in making bean hay.

(4) Legume silage supplies a suitable succulent high in protein during the winter months.

(5) The silage packs very tight and requires less silo space, weight for weight, than maize silage.

(6) Legume silage is much easier to pack in or remove from pits without previous cutting than maize silage.

Disadvantages.—(1) *Cost of Molasses.*—When molasses silage was first recommended the molasses had to be imported into Southern Rhodesia from the Union of South Africa and cost 50s. to 55s. per 45 gallon drum landed, *i.e.*, approxi-



1.—Load of cowpeas on the way to the silo pit.

2.—The type of grade Angus x Africander steers used in Trial II.

The type of Grade Angus x Africander steers used in Trial II.

mately 1s. 2d. per gallon. At this high price the addition of 2 per cent. of molasses to the green material raised the cost of the silage by approximately 3s. per ton, which was too high to interest any farmer in the making of molasses silage. Recently, however, the Rhodesia Sugar Refinery has commenced operations in Bulawayo and the molasses can at present be obtained in Bulawayo at approximately 5d. per gallon, or 1s. 1d. approximately per ton of silage, which is a more economic figure.

(2) *Silo Pits.*—Because of the large quantities of legumes necessarily grown if silage is made more silage pits will be required than are usually found on the average farm.

Substitutes for Molasses.—Considerable information is available from overseas sources to show that legume crops can be successfully ensiled when mixed with crops, such as maize, which are high in sugar.

To test these findings under local conditions and to determine what proportion of green maize, cut at the usual silage stage, it would be necessary to mix with the green legume to ensure satisfactory silage, a small experiment was carried out at the Rhodes Matopo Estate.

The following lots of silage were made:—

Lot I.—Maize only.

Lot II.—$\frac{1}{2}$ maize plus $\frac{1}{2}$ cowpeas.

Lot III.—$\frac{1}{3}$ maize plus $\frac{2}{3}$ cowpeas.

Lot IV.—Cowpeas only plus 2 per cent. molasses.

Before the different lots of silage were made the total quantity of maize and cowpeas for the lot was weighed out, cut up separately, thoroughly mixed and representative samples taken for analysis. The silage was then well tramped down into 45 gallon iron drums and sealed. After a 90-day period the drums were opened and the different lots of silage carefully examined and sampled for analysis.

The composition of the different samples is given in Table III.

TABLE III.

Composition of different lots of Silage and Green Material—Expressed as 100 per cent. Dry Matter.

Lot.		Acid Sol. Ash.	Crude Protein.	Ether Extract.	Fibre.	Sol. Carbohyds.	Quality.
I.	Maize before ensiling	4.7	6.9	1.2	31.4	52.5	Very
	Maize silage	3.4	6.3	1.4	27.0	58.8	good.
II.	Cowpeas before ensiling	9.0	19.1	2.0	22.1	46.5	do.
	Cowpeas molasses silage	8.1	17.1	8.3*	19.1	46.1	do.
III.	$\frac{1}{2}$ maize $\frac{1}{2}$ cowpeas before ensiling ...	7.3	14.1	1.7	29.1	45.6	do.
	$\frac{1}{2}$ maize $\frac{1}{2}$ cowpeas ensilage	6.9	13.0	1.6	26.8	50.0	do.
IV.	$\frac{1}{3}$ maize $\frac{2}{3}$ cowpeas before ensiling ...	7.9	16.1	1.8	24.4	47.7	do.
	$\frac{1}{3}$ maize $\frac{2}{3}$ cowpeas silage	6.5	13.8	2.7	25.2	50.3	do.

A study of this table will show that there was no appreciable loss of nutrients in either of Lots II., III. or IV., and that the mixture of green maize with the cowpeas was as effective as the addition of 2 per cent. of molasses.

It must be emphasised, however, that when legumes are ensiled with another green crop it is necessary that both the green crop and legumes be cut up together while ensiling and thoroughly mixed, and *not* packed in layers. Unless they are cut up it is not possible to mix the material thoroughly and inferior quality silage will result.

*No explanation is available for this high figure.

Smut Diseases of Wheat in Southern Rhodesia.

By G. M. Wickens, B.Sc. Agric., Ph.D., D.I.C. Plant Pathologist, Tobacco Research Station, Trelawney.

Recently the writer has been informed that the quality of the flour milled from Rhodesian-grown wheat last year was much impaired by the presence of "smut," and it is understood that in future much lower prices will be paid for smutty samples. This article is therefore written in order that growers may be informed of the nature of the disease and of the steps they may take to safeguard themselves from possible serious monetary loss arising therefrom.

There are two forms of smut disease that attack the wheat grain and are known to occur in Rhodesia. Although closely similar in many respects, the fungi causing them differ widely in their life histories and in consequence the two diseases require different treatments for their control. Although the writer has not seen samples of the affected flour, it is safe to assume that one of these forms only is responsible, namely, Bunt or Stinking Smut. Fortunately this disease is easily and cheaply controllable. The other form, known as Loose Smut, may cause appreciable reduction in yield, but is unlikely to affect the quality of the flour milled from an affected crop.

BUNT OR STINKING SMUT.

Description of the Disease.— Except to the trained eye, plants affected with this disease appear externally little different from normal plants. At heading time affected plants are usually of a darker green colour than normal, and before ripening smutted heads are also of a somewhat darker colour than healthy heads. When these smutted heads are examined closely they are found to contain smut balls in place of the normal kernels. These smut balls are of similar shape to the

kernels, but are usually shorter and thicker, causing the glumes of chaff surrounding them to be more spread out than in healthy heads. When broken, the smut balls are found to consist of a shell full of a mass of black sooty powder of unpleasant fishy odour—hence the name stinking smut. A sample of wheat containing numbers of smut balls is unsatisfactory for milling purposes, for, unless cleaned by special machinery, the dark colour and offensive smell of the black powder is communicated to the resultant flour.

The black powder consists of vast numbers of spores—the reproductive bodies of the fungus causing the disease. During threshing some of the smut balls are broken, and the spores are distributed over the healthy seed. If the crop is severely affected, the spores are present in such abundance that the tips and grooves of the sound grain are blackened and the presence of infection on the seed easily discernable to the naked eye. If the crop is less affected no visible discolouration occurs, and the seed sample may appear to be free of the disease; nevertheless, most of the grains may carry a few spores and, when sown, give rise to smutted plants.

Thus it is most important to remember that, unless it is absolutely certain that the crop from which the seed has been saved was completely free from Bunt (a state of affairs unlikely to occur), the seed must be treated as described below to ensure freedom from the disease in the ensuing crop.

Infection of the wheat plant by the fungus causing this disease occurs only when the seedling is very small, and at no other stage in its life. If the seed is sown with spores adhering, they germinate together and the germ tube of the fungus enters the young shoot. During growth the fungus maintains itself at the apex of the plant, finally entering the ear and, utilising the food materials that normally would go to the formation of the grain, forming in place of the latter the black mass of spores described above. The object of seed treatment is to destroy or prevent the germination of, the adhering spores, thus protecting the young seedling from infection and rendering the ensuing crop free of the disease.

Control of the Disease.—The older method of treating seed with liquid disinfectant has now been largely superceded by

the "dry method," in which the seeds are coated with a fungicidal dust, the latter method removing a number of disadvantages inherent in the former.

There are three efficient fungicidal dusts for seed treatment readily obtainable in this Colony, namely, Copper Carbonate (specially prepared for seed treatment), Agrosan G., and New Ceresan. No experiments have as yet been conducted in this Colony on the relative efficiency of these materials as seed dressings for wheat under local conditions, and so it is necessary to be guided by the experience and experimental data obtained in other countries.

Agrosan G. (which should be applied at the rate of 6—7 ounces per 200 lb. bag of seed) has given results in controlling Bunt on a par with those obtained with Copper Carbonate. It may have an additional advantage in giving also efficient control of seedling blight diseases*, but is more expensive.

New Ceresan has also been found highly efficient in controlling both Bunt and seedling blight disease, but has apparently a rather small safety margin. There appears to be danger of marked reduction of germination if this material is applied at a rate greater than about 2 ounces per 200 lb. bag of seed, and also risk of damage if treated grain is stored for some time before planting.

Over a large number of years Copper Carbonate has given highly efficient control of Bunt, and it has the advantages of cheapness and safety, excessive doses and prolonged storage of treated seed causing no injury to germination. At least until such time as controlled comparative experiments can be carried out under local conditions, this material, applied at the rate of 7 ounces per 200 lb. bag of seed, can be most strongly recommended. *The cost of seed treatment with this material will be about 2d. per acre of wheat sown.*

It has repeatedly been demonstrated that efficient control of Bunt is not obtained by merely mixing the grain and

*But it is not yet known to what extent seedling blight diseases affect the stand and yield of wheat in this Colony.

fungicidal dust with a shovel. It is essential that they be thoroughly mixed in a machine. A simple and efficient type† that can easily be made on the farm is described below.

From an ordinary 40-gallon oil drum a half of one head is cut out. To the top of the remaining half is bolted a board 1 inch thick and 6 inches wide, and of a length such that it fits snugly against the inside rim of the drum, allowing 1 inch of the cut edge of iron to extend beyond the edge of the board. A semi-circular wooden door is then cut to fit the open half of the head, and hinged to the 6 inch board. A strip of old inner tube nailed along the edge of the door will help to make it dust tight. A hasp is then attached to hold the door tightly to the edge of the drum when closed. The axle, ¾ inch or 1 inch piping, is made to pass diagonally through the drum and may be bolted or (preferably) welded to it. A mixing board, 1 inch thick by 6 inches wide, is nailed or screwed edgewise across the full inside width about two-thirds of the way from the opening. The mixer may then be mounted on trestles or on posts of native timber, and is ready for use.

An alternative method, suitable if time or opportunity does not allow of the construction of the above, would be to cut a hole in the end of a drum sufficiently large to receive the seed comfortably from the bag, and fit a dust tight door similar to that described above.

To treat the seed, the drum is filled to about one-third of its capacity, the requisite amount of dust added, and the lid tightly closed. If the machine mounted on supports be used, the drum is rotated for a sufficient length of time for every seed to be thoroughly coated with the dust. If the drum alone be used, it should with its contents be rolled along the ground. In either case about five minutes of fairly vigorous rotation should be sufficient.

The operation should be carried out in the open or in a well ventilated draughty place, because the dust is very fine and the inhalation of any appreciable quantity will cause illness.

Copper carbonate tends to sift into all working parts of the drill. To avoid possible damage to feed shafts and gears, the feed shafts should be twisted with a wrench to free the feed wheels after the drill has stood overnight or longer.

LOOSE SMUT.

In marked contrast to Bunt, this disease is very noticeable as soon as the wheat heads out, the heads being almost com-

†Designed by R. S. Kirby, Pennsylvania State College, U.S.A.

pletely destroyed before normal heads are ripe. In place of the normal chaff and flowers, black sooty masses consisting of the spores of the causative fungus, appear along the axis of the head. The spores are easily shaken from the smutted heads and are readily carried long distances by wind, so that at harvest time bare stalks almost devoid of chaff and grain are the only evidence of the presence of the disease.

Some of these spores may lodge in the flowers of healthy plants during the short time that the glumes are open during flowering. Here they germinate and their germ tubes enter the very young wheat kernels. Infected kernels develop normally, and cannot be distinguished when mature from healthy grain. But if infected grains be later sown, the fungus within the seed develops also and maintains itself at the apex of the plant, finally destroying the head.

It is most important that the difference between the life histories of the fungi causing Bunt and Loose Smut be clearly understood. In the former disease the spores of the fungus come into contact with the exterior of the grain, and when the seed is sown the spores germinate and cause infection of the young seedling. The fungus is present *only on the outside* of the seed, and can be prevented from causing infection of the seedlings by treatment as described above. On the other hand, infection by the Loose Smut fungus takes place at a much earlier stage, namely, in the very early stages of development of the wheat kernel, so that infected seeds carry infection not on the surface where it is easily controlled, *but within their tissues.* For this reason surface disinfectants that control Bunt can not control Loose Smut.

It is possible, by immersion of the seed in hot water at a given temperature for a certain time, to destroy the Loose Smut fungus within the kernels without very markedly injuring the seed. But the operation is tedious and exacting, and however accurately performed more or less injury to germination results.

Fortunately at least a large proportion of the wheat grown in Rhodesia flowers at a time when atmospheric humidity is very low—a condition unfavourable to infection of the flowers by the Loose Smut fungus. Where irrigation is practised, it is recommended that during the flowering period water be withheld as far as possible. It is unlikely that Loose Smut will become a serious disease of wheat grown in the Rhodesian winter, but farmers should, at the flowering stage, examine their crops closely for the possible presence of this disease. If present to any appreciable extent, it will be necessary to treat seed saved from the crop by the tedious hot water method, or alternatively to buy seed from a crop known to be free from it.

Report of the Tobacco Research Board

FOR THE YEAR ENDING DECEMBER 31st, 1936.

By CHAS. K. BRAIN, M.A., D.Sc., Director of Agriculture and Chairman of the Tobacco Research Board.

Tobacco Research Board.—The Board consists of the following members:—W. J. Field, Esq., and Capt. R. D. James, representing the growers; C. A. Barron, Esq., and J. Reid Rowland, Esq., representing the Tobacco Section of the Chamber of Commerce; Dr. C. K. Brain (Chairman) and D. D. Brown, Esq., Chief Tobacco Officer, official members.

During the absence on leave of Messrs. C. A. Barron and J. Reid Rowland their places were taken by K. G. Y. Browne, Esq., and G. Hodgson, Esq., respectively.

Meetings, etc.—Ten regular meetings of the Board were held during the year, four of which took place at Trelawney.

The Board entertained His Excellency the Governor to luncheon at Trelawney Research Station on March 10th.

The official members of the Board paid two visits to Mr. Strickland's farm, Lion's Den, Shamva, where the fire-cured tobacco experiments were conducted.

At the request of the Government Professor M. Nierenstein again visited Southern Rhodesia during April and May to discuss tobacco research with the Board and with the technical staff. The latter met Dr. Nierenstein in Salisbury on April 28th and prepared a programme for future research which was submitted to a meeting of the Board on 6th May, when it was approved in the following form:—

1. *Plant Breeding Programme.*

(*a*) Continuation of the selection and improvement of varieties which have, as regards quality, flavour, etc., proved to be suitable for our conditions.

(b) Hybridisation of promising varieties.

(c) Genetical studies of special varieties.

(d) New Introductions.—It is suggested that this should form only a strictly limited and rapidly diminishing part of the work of the Station, as only very outstanding introductions should be continued for more than one season.

2. *Physiology.*

(a) Nitrification of soils.

(b) Vernalisation to be checked by a complete nitrogen analysis.

(c) Measurable characters as affected by environment.

3. *Crop Conditions and Field Trials.*

(a) Spacing trials on different varieties to test improved quality and yields.

(b) Rotation Trials.—Subsequent effect of various crops to be tested in regard to the quality of the tobacco.

(c) Topping and priming trials on different varieties.

(d) Method and time of application of fertilisers.

(e) Phosphate trials.

4. *Disease Control.*

(a) Investigation of tobacco disease in general.

(b) Nematode experiments on Roxburgh. Source of infection, water supplies, weeds, etc.

5. *Curing Investigations, Barn and Furnace Construction.*

(a) Continuation of work and development of new lines of investigation as facilities become available.

(b) Critical investigations of different varieties for texture, flavour and general curing quality.

(c) Enzyme action, etc., during curing.

6. *Chemistry.*

1. A complete study of the chemistry of soils, fertilisers used and of the cured leaf obtained from :—

(a) Special selections.

(b) Various fertiliser treatments.

2. A chemical study of cured tobacco collected from different areas of the Colony as a control of commercial samples submitted to manufacturers for report on smoking quality and flavour.

TRELAWNEY RESEARCH STATION.

Buildings and Equipment.—The essential buildings were all completed before the beginning of the year. These comprise houses for the Director and Foreman, two sets of single quarters each to accommodate three members of the single staff, the laboratory, barns, curing chambers, grading shed, etc.

The laboratory building has in addition to office, library, seed store, etc., three rooms specially equipped for carrying out experimental work in plant breeding, physiology and plant diseases. There are two sets of barns, one comprising three 12 ft. x 12 ft. x 16 ft. barns and the other two standard barns, *i.e.*, 16 ft. x 16 ft. x 20 ft. The experimental curing chambers which are 6ft. x 6 ft. x 8 ft. were not satisfactorily equipped for the last season's work, as it had been found impossible to determine the most suitable means of heating by steam to maintain suitable temperatures throughout the whole range required.

The Irrigation Engineering Branch have now made the necessary alterations and the small chambers should prove to be of exceptional value for curing small experimental lots of tobacco.

Staff.—During the early part of the year the staff consisted of:—J. C. Hopkins, D.Sc., Senior Plant Pathologist, officer in charge; H. F. Ellis, M.Sc., Tobacco Research Officer; A. A. Moffett, B.Sc., Ph.D., Tobacco Plant Breeder; H. C. Thorpe, B.Sc., A.I.C.T.A., A.R.C.S., Tobacco Plant Physiologist; J. C. Collins, B.Sc., Lay Assistant; V. G. Smith, Lay Assistant; R. R. Slocock, clerk; F. Scammel, farm foreman.

During the year several staff changes took place. Messrs. Smith and Slocock left to take up other appointments. From September 1st Dr. J. C. Hopkins returned to Salisbury to take up his duties in the Department again. Mr. H. F. Ellis was then appointed acting officer in charge and Dr. W. M.

Wickens assumed duty as Plant Pathologist. Mr. H. M. Murray, B.Sc., has been appointed as Chemist at Trelawney from January 1st, 1937. These changes were made on the recommendation of the Board, as they were considered necessary to carry out the programme of work approved for the present season. Mr. J. C. Collins was made responsible for the nematode investigations, and although a plot of ground known to be heavily infested was surveyed for this purpose, it was discarded later in the year in favour of a portion of another farm much nearer to the Trelawney Station..

1935-36 SEASON.

Climatic Conditions.—The season opened very badly with little rain in November, 1935. Only in the east and north was more than two inches registered, the remainder of the Colony getting one inch or less. The December rainfall was very poor until the 20th of the month, when the rain became more general. The north-eastern parts of the Colony had fair rains, but the remainder less than half the normal amount for the month. The general rains which set in on December 20th continued until about the 20th January, but the extreme south of the Colony had little or no rain before the middle of the month. February, however, had the heaviest rainfall recorded for this month since 1926, and good rains continued until about the middle of March, when the rainfall for the remainder of the rainy season became patchy.

Cultural Experiments.—The Tobacco Research Officer (Mr. H. F. Ellis) was in charge of this section of the work and the following notes are based upon his report on the 1935-36 season:—

Experimental Seedbeds.—A number of experimental seedbeds were laid down to test, among other things, the rate of thinning, rate of sowing and rate of fertiliser application. General observations on rate and type of growth as affected by fertiliser indicated that, considering density, early maturing and development of a good root system the best application consisted of 1 lb. of 20—7—10 fertiliser for every 5 yards of seedbed, the width of the seedbed being 3½ feet. The rate of thinning trials yielded very little information, though it appeared that to obtain a large number of suitable plants per

bed, the seedlings should be spaced 2 to 2½ inches apart. The rate of seeding experiments indicated that in order to obtain good density, and to reduce the necessity of thinning out considerably, a rate of sowing slightly below 1 teaspoon per thirty square yards was most suitable; 4-5ths of a teaspoon per 30 square yards with seed of a high germination gave the best results. Best results were uniformly obtained where the seed-bed was left rather rough. When broken down to a very fine tilth it was found that the seed tended to wash together, and the distribution of the plants in the bed was irregular.

Condition of Experimental Plots.—Owing to the scanty rainfall early in the season it was not possible to plant the main series of experimental plots until November 23rd. After this planting there was no rain of any consequence, half an inch in all, until December 16th, and heavy losses occurred and replanting could not be done until December 17th. Although a satisfactory stand was subsequently obtained, yet most of the plots were uneven. This condition naturally increased the difficulty of making adequate field notes on type, rate of growth, etc.

Mosaic, Leaf Spots, etc.—Despite elaborate precautions in the field, mosaic was again prominent, though the crop was not affected to the same extent as in the previous year. Owing to very favourable climatic conditions later in the year, the leaf thickened up considerably and the subsequent mottling largely disguised the effect of the disease. A number of small plants in the seedbeds were found to be infected with the disease, and it is certain that the subsequent infection in the lands was largely due to this source. Such infection probably originated during the process of thinning out by hand, a practice which in the light of the experience of the past two years should be strongly discouraged. Observations made in the land showed that the first symptoms of mosaic appeared some three weeks after planting out, though five weeks usually elapsed before the disease appeared generally. In a season such as the past where the plants grew very slowly after setting out, it is not advisable to give tobacco its first priming for at least five weeks after planting. This was the policy adopted and was very successful, as the leaf from all the series treated in this way was completely free from frog eye and barn

spot. The method generally adopted was to prime fairly high five weeks after planting, and to give a final priming at the topping stage. In one series, namely, the phosphate trials, the priming was delayed and picking was somewhat hampered due to lack of barn accommodation. In consequence all the leaf reaped from these plots was badly affected with barn spot and the average price per pound was materially lowered.

Time for Application of Fertiliser.—This experiment was laid down with a view to determining whether best results were obtained by applying the fertiliser to tobacco in one or two doses. All plots received a standard dressing of 200 lbs. per acre of 20—7—10 tobacco fertiliser and were planted on second year land. The treatments tested were as follows:—

A.—All fertiliser applied before planting.

B.—Half before planting and half four weeks later.

C.—All fertiliser applied four weeks later.

The yield from each plot and the price per pound were the points upon which this experiment were judged. From a detailed examination of the results Mr. Ellis concluded as follows:—

It should be emphasised that while the results show certain trends, the experiment is not statistically significant and the results may well be due solely to chance. It is not therefore possible to make any definite statement that one particular treatment may be expected to give better results than any other.

Though the experiment is not statistically significant according to Fisher's Z test, there is a wide range of difference between treatments which permit certain conclusions to be drawn. The yields increase rapidly as the fertiliser is applied later, the difference amounting to 300 lbs. per acre when the fertiliser is applied after planting as compared with when it is applied before. The value per acre also increases very rapidly. Where the fertiliser is applied half and half there is a large increase in value as compared with the treatment where all the fertiliser is applied beforehand, and an increase though rather smaller is shown over the half and half where all the fertiliser is applied after the planting. There is material increase in quality of the leaf produced by fractional applica-

tion as compared with fertilising both before and after planting, though the increase is considerably greater in the former case.

Method of Application of Fertiliser.—This series is a continuation and in some respects an elaboration of that laid down last year, the purpose being to determine whether the method of application had any effect on the yield and quality of the resulting tobacco. It was considered that it might be possible by spreading the fertiliser out as much as possible to encourage the plant to form a greater root system thus enabling it to have a wider feeding range and resist drought better.

The following methods of applying the fertiliser were included in the experiment:—

A.—Ridges thrown up and fertiliser distributed in holes around grass stalk which marks the future planting site.

B.—Fertiliser distributed in circles of 12 inches diameter and hilled up.

C.—Drilled in row and ridged.

D.—Broadcast.

In the season 1934-35 the difference between treatments was so small as to be negligible, and the same remarks apply this year. Such little differences as there are, are simply due to chance effects. Provided the fertiliser is properly distributed it seems probable that under the present system of field management it does not matter in what manner the fertiliser is applied.

Method of Planting.—A small series was laid down to determine the effect on yield and quality of planting on the flat and planting on hills. These were in all three treatments laid out in the form of two Latin squares. The treatments were as follows:—

A.—Planted on flat and remaining so throughout the year.

B.—Planted on flat and ridge gradually built up at subsequent cultivations.

C.—Planted on hills.

One of the primary objects in view with treatment B was to ascertain whether it would be possible by gradually throwing up a ridge to cover the lower diseased leaves and obviate the necessity of priming. This object was achieved by gradual hand cultivation, though it is doubtful if it is not more expensive than priming.

The usual method of assessing the results was followed, *i.e.*, total yield and price per pound, and it was found that under the conditions prevailing in this particular season no difference whatever could be discovered.

Spacing Trials.—A small series of spacing trials had been laid down in two previous years, and as they had yielded certain results of promise the subject was investigated more fully. In the work of the previous years, only three spacings had been investigated, in each case the distance between the rows had been kept constant, and only the distance apart of the plants in the row had been varied. The treatments tested had been as follows:—

A.—Rows 3 feet apart, plants 3 feet apart in rows.

B.—Rows 3 feet apart, plants 2½ feet apart in rows.

C.—Rows 3 feet apart, plants 2 feet apart in rows.

Each of these series was treated with two levels of fertiliser.

1.—200 lbs. per acre of 20—7—10.

2.—400 lbs. per acre of 20—7—10.

During the season 1934-35 a response was shown to the double dressing of fertiliser, while closer spacing increased the yield and the quality of the tobacco produced, but better results generally were obtained where the plants were set out 3 feet x 2½ feet than with either of the other spacings.

In the new series this year both the spacing between the rows and between the plants in the row was varied within fairly wide limits, to try to ascertain the optimum range. The general fertiliser application was constant at 300 lbs. per acre of a fertiliser analysing 18—6—8. Some twenty different spacings were under trial, ranging from 2 feet 6 inches to 4 feet 6 inches between the rows, while the plants were set 18 inches to 3 feet apart in the rows. Owing to the necessity of replication and the consequent large size of the experiment,

five large blocks were made where only the treatments within each block were strictly comparable. In each block the rows were kept the same distance apart and only the distance between the plants in the rows was varied. In each block the treatments were :—

A.—18 inches apart in the row.

B.—2 feet apart in the row.

C.—2 feet 6 inches apart in the row.

D.—3 feet apart in the row.

In Block 1 the rows were 2 feet 6 inches apart.

In Block 2 the rows were 3 feet apart.

In Block 3 the rows were 3 feet 6 inches apart.

In Block 4 the rows were 4 feet apart.

In Block 5 the rows were 4 feet 6 inches apart.

There were thus four treatments in each block, each of which was replicated four times, each block being laid out in the form of a Latin square. None of the results between different blocks are comparable; the experiment was laid down with a view to obtaining the best treatment from each block, which would be tested in a strictly comparable experiment during the coming season. It cannot be claimed that the experiment tested strictly the effect of spacing on yield and quality, as with a uniform application of fertiliser per acre each plant obviously could not receive the same application of fertiliser. The experiment was designed purely and simply to ascertain what spacing gave optimum yields and value of tobacco, with a given application of fertiliser per acre.

In all the treatments where the plants were spaced 18 inches apart in the rows, there was, after any short period of dry weather, considerable wilting at midday, though this was in no case observed where the plants were set more widely apart. Some six weeks after planting, tobacco set 18 inches apart in the rows showed a definite tendency to lankiness and became a very pale green in colour, while the leaves tended to become very short and narrow. All these plots gave a very high yield, due largely to the number of plants they contained, but the quality of the tobacco in general was poor. The majority of the leaf, though very bright, was short, contained little gum and was harsh and woody in feel.

Based purely on field observation, the practice of setting rows 2 feet 6 inches apart cannot be recommended, as it renders the use of ox drawn cultivators very difficult and makes it almost essential that the whole of the cultivation be performed by expensive manual labour.

A definite relationship was observed between the closeness of spacing and the rate and time of maturity. In general, it can be said that the larger number of plants per plot the earlier and more quickly did the plants mature. The effect was more pronounced within blocks than between blocks, that is to say, that the closeness of spacing in the row had more effect than the distance between the rows.

The yields per acre and the price per lb. were worked out for each treatment, and although this type of experiment has to be repeated for a number of seasons so as to eliminate climatic effects, etc., yet certain fundamental facts appear to be evident. These are summarised by Mr. Ellis as follows:—

As the spacing is widened there is a noticeable decrease in bright leaf, and a similar increase in that of medium type. For the first time in these series the percentage of medium type exceeds that of the brights in treatments C and D. This shows that with exceptionally wide spacing between the rows such as these treatments have received, there is a tendency for the tobacco to become definitely darker in colour. Though the percentage of short leaf decreases as the spacing is widened, the decrease is not nearly as great as in the previous series, tending to show that as the spacing between rows is widened, the effect of closeness of spacing in the row on the percentage of short leaf, is decreased.

For any given spacing between the rows, the percentage of brights tends to be raised as a spacing between the plants in the row is decreased, though this effect is not particularly noticeable until the spacing between the rows attain the distance of 3 feet 6 inches. Similarly for any spacing in the row, it can be seen that the percentage of bright leaf tends to decrease, and that of the medium leaf to increase as the spacing between the rows is widened. So long as the distance apart of the rows remains constant the percentage of short leaf decreases rapidly as the spacing of plants in the row is

increased. The percentage of bright and of medium tobacco produced is influenced both by the width between rows and the distance apart of the plants in the row. The effect of the latter factor is usually greater than that of the former. The width between the rows has very little effect on the amount of short leaf produced, in each case the dominating influence determining this percentage is the distance that the plants are set in the row.

Samples of tobacco from each of the above treatments have been kept, with a view to subsequent analysis and smoking tests. It has been demonstrated elsewhere that closeness of spacing has an influence on the nicotine content of tobacco, a fact which might be worth investigating in relation to the smoking quality of the tobacco.

Topping Trials.—A fairly elaborate series of topping trials was laid down with a view to ascertaining the optimum time and height of topping. In conjunction with these experiments two different levels of fertiliser were applied, one series receiving 200 lbs. and the other 400 lbs. per acre of 20—7—10 fertiliser to observe the effects of similar topping treatments on tobacco treated with low and high dressings of fertiliser. The plots were so arranged as to include topping at three different stages and at two different heights. The stages selected were:—

A.—Early bud stage, *i.e.*, when the bud shows well above the leaves.

B.—Early flower stage, *i.e.*, when approximately three flowers are opened.

C.—Full flower stage, *i.e.*, when the plant is in full flower and has already set two or three seed pods.

In these experiments, which is one of considerable interest to tobacco growers, the *total* yield and percentage of discard leaf were also taken into account. It was concluded that the actual height of topping has very little effect, but in every case it was found that the earlier the tobacco is topped the lower is the percentage of poor quality tobacco. Experience indicates that when normal heights of topping are adopted the stage of topping has more effect on the quality of the leaf than any other factor, and that in the past season best results were obtained by topping at the early bud stage.

Similar treatments have been tested during the past four years, *i.e.*, for three years at the Salisbury Station and for one season here. In the year 1934-35 the experiment was a failure, as the plants were too small to be really worth reaping or topping and no results were obtained.

In the work carried out at Salisbury, however, over three years, where the same stages of topping were tested and where the plants were topped to 10, 12 and 14 leaves respectively, certain definite results were obtained. When topped to 12 or 14 leaves there was little difference in yield or quality, whereas when the plants were topped to 10 leaves, the leaves produced were harsh and coarse, and the yield per acre was materially lowered.

In general the stage of topping had more effect than the height of topping in each year, and as an average, the plants topped in the early bud stage gave better yield and quality than either of the others, late topping, *i.e.*, topping in the full flower stage, gave consistently poorer results than either of the others.

Phosphatic Fertiliser Trials.—This series was originally laid down for the first time at the Salisbury Station during the season 1932-33. The 1933-34 crop was destroyed by hail so that the results from this year's experiment complete the third year of the trial. The original design was to test the amount of phosphate per acre needed for the normal development and growth of the plant, as the supposition had been advanced that the present application of phosphate per acre was too high.

A standard dressing of nitrogen and potash was applied and only the total application of P_2O_5 was varied, the source of which was double supers 40 per cent.

The following treatments were tested:—

A.—10 lbs. P_2O_5 per acre.

B.—20 lbs. P_2O_5 per acre.

C.—30 lbs. P_2O_5 per acre.

D.—40 lbs. P_2O_5 per acre.

E.—50 lbs. P_2O_5 per acre.

Previous experience of this series has shown that additional phosphate over 20 lbs. per acre has little influence on the yield of tobacco, though the quality and value reach their maximum as the application of P_2O_5 rises to 30 lbs. per acre.

In this series there is a gradual and definite increase in quality (as shown by price per lb.) as the quality of phosphoric oxide is increased, while there is a corresponding decrease in the percentage of low grade, badly spotted tobacco produced. There seems, therefore, to be some slight evidence that where normal field precautions for the control of disease are neglected the standard dressing of 40 lbs. P_2O_5, or one having a slightly larger total application, may have a beneficial effect on the amount of diseased leaf produced.

Based on the time of opening of the flowers and the proportion of green leaf harvested at each picking, there is no difference between any of the treatments as regards the time or rate of maturity.

Rotation Trials.—The series of three years rotational trials previously laid down has been continued. The five rotations are as follows:—

1. Tobacco, maize, sunnhemp, tobacco.
2. Tobacco, sunnhemp, maize, tobacco.
3. Tobacco, cowpeas, summer oats, tobacco.
4. Tobacco, soya beans, Kaffir corn, tobacco.
5. Tobacco, Sudan grass, munga, tobacco.

This trial has not been in progress sufficiently long to enable many results to be reported. Last year best quality leaf was obtained from tobacco following summer oats or munga. A crop of Kaffir corn ploughed under acted as a harbour for numbers of wireworm and it was rather difficult to get a stand of tobacco in the plots following this crop. Except on heavy patches of soil soya beans, even when inoculated, made very poor growth, whereas the growth of cowpeas, which were cut for hay, was uniformly good. Despite the poorness of the soil, maize was uniformly good, particularly where it came on a land which had carried tobacco the previous year. Summer oats, Sudan grass, munga, sunnhemp and particularly Kaffir corn all made very good growth, though the soil was poor and none of these crops received any direct application of fertiliser.

In addition to this series a large number of 1-10 acre plots were laid down to different crops on a land which had previously carried one crop of tobacco, to ascertain whether they were suitable for growing in this district, and what would be their effect on a subsequent crop of tobacco.

The treatments laid down were as follows:—

1. Continuous tobacco.
2. Teff.
3. Munga.
4. 1, 2 and 3 years bare fallow.
5. 1, 2 and 3 years fallow.
6. 1, 2 and 3 years Rhodes grass.
7. Purple top Buffel.
8. Natal red top grass.
9. Gonya grass.
10. Cotton.
11. Mlanje grass.
12. Boer manna.
13. Kaffir corn.
14. Wintersome.
15. 2 and 3 year perennial Sudan.
16. Urochloa Bolbodes.
17. Proso millet.
18. Brabban cowpea.
19. Somerset velvet bean.
20. Sunnhemp.
21. Dolichos bean.
22. Soya bean.
23. Peanuts.
24. Brachiaria dictyoneura.
25. Nandola bean.

Of the fine stemmed grasses mentioned above, three were particularly outstanding in the amount of hay they produced and ease with which they grew, *viz.*, teff, Rhodes grass and Gonya grass. The latter might well prove to be well adapted to an area such as this, as even now (late September) it is still showing a considerable amount of green. Teff gave a very fine hay and yielded at the rate of over $1\frac{1}{2}$ tons an acre. Once established Rhodes grass came away well and still remains comparatively green. Of the other seeded grasses

both Purple Top Buffel and Natal Red Top were quite good, but Urochloa bolbodes was disappointing, particularly in the amount of forage produced. Of the grasses planted from cuttings little can be said, as they had to be planted too late in the season to allow them to form a sod. With us, a better take was obtained with the Mlanje grass than with the Brachiaria dictyoneura, which gave quite a lot of difficulty. Of the different millets, sorghums and coarse stemmed grasses, Wintersome and Perennial Sudan grass grew slightly better than the majority of the others, though there was really very little to choose between any of them. Proso millet proved itself to be a very rapidly maturing plant, and should prove very suitable in old tobacco lands for any grower who requires a large quantity of poultry food.

Of the leguminous crops tested, the soya bean was quite the worst. The majority of the others grew very well. Peanuts gave an excellent crop, and the velvet beans gave a greater yield of hay than the dolichos. The Brabbon cowpea, which is resistant to eelworm, also did well and gave a nice type of hay. The Nandola bean sent by Dr. Arnold from Nyasaland is making good growth, though it is a very late maturing type, taking some seven or eight months to set seed. It is questionable whether it will be of much use for hay as its habit of growth is very similar to sunnhemp.

Though planted very late cotton did well, and despite early frosts, opened its bolls and yielded well. If the quality of the tobacco which succeeds cotton is satisfactory it should prove a very useful crop in the lower lying regions where it can be matured.

REPORT OF TOBACCO PLANT BREEDER.

The Tobacco Plant Breeder, Dr. A. A. Moffett, was appointed in England during the previous year. The year under review represented, therefore, his first experience of growing tobacco. On his arrival from England he, in company with Mr. Thorpe, the Tobacco Plant Physiologist, was given every opportunity of becoming acquainted with tobacco

in all stages. Several days were spent at the auction floors and the tobacco growing on farms near the Experiment Station was available for observation. The following extracts from Dr. Moffett's report indicate the scope of the work undertaken during the last season.

General.—The selections and varieties grown during 1935-36 were for the most part a continuation of those grown during the previous year. Being unfamiliar with the material, and no records as to the types of plants previously selected being available, it was essential to grow practically all selections, varieties, and the progeny from crosses and to discard subsequently. A number of new importations were also grown.

As the value of this year's selections cannot be assessed until they have been grown next year this report is concerned mainly with methods used for selection and types selected, and a brief description of the more promising varieties.

The following varieties and progeny from crosses were grown:—

New Varieties, 16 *in all.*

1. Mosaic resistant from Cuba.
4. Varieties from Mauritius.
2. Varieties from Brazil.
1. Giant variety, local.
8. Varieties from Russia.

Varieties which have been grown for one or more years, 49 *in all.*

A.—Varieties which have been grown for several years.

1. White Stem Orinoco, Jamaica Wrapper, Willow Leaf, Cash, Hickory Pryor (two selections from each).
2. White Stem Orinoco and Hickory Pryor selected for maximum and minimum nicotine content.
3. White Stem Orinoco, Jamaica Wrapper, Cash and Willow Leaf selected for smallest ruffle.

B.—Varieties introduced season 1934-35 from U.S.A., Canada and Vumba (two selections from each).

From U.S.A.

Adcock.
Bonanza.
Cash.
Gold Dollar.
Jamaica.
Moss Special.
Virginia Bright Leaf.
White Stem Orinoco.

From Canada.

Bonanza.
Virginia Bright.
White Stem Willow Leaf.
White Stem Orinoco.
Warne.
Yellow Pryor.
Yellow Mammoth.

From Vumba (Umtali), S. Rhodesia.

Vumba.

Hybrids.—120 selections from the crosses Hickory Pryor x Cash and Hickory Pryor x Warne.

Seedbeds and Planting.—Seedbeds were divided up by brick partitions, two yards being allowed for each plot of 200 plants. All seedbeds were duplicated, the first sowing being made on 14th October and the second on 30th October. The first planting made on 25th November was followed by a long period of drought by which approximately 50 per cent. of the plants were destroyed. The plots were refilled during the next rain on December 17th. The result was the growth of the plots was very uneven and measurements and selection were rendered very difficult. The Russian varieties showed a marked drought resistance, the stand at the end of the dry period being up to 95 per cent.

Selection.—A considerable amount of time was devoted to evolving suitable methods of making selections, and of recording the characters selected. The technique of selection is of particular importance in tobacco where it has been shown that a large number of genetical factors are concerned in the expression of any one character, with the result that inheritance is never clear cut but always of a graded type. It is of fundamental importance that once the line of selection has been decided upon, it should be rigorously adhered to from year to year. If this is not done, owing to the number of genetical factors involved the plant is maintained in a state of flux and no great advance in breeding can be made. It was necessary therefore to devise some method by which the morphological characters of the plant could be recorded

accurately and the records used as a basis for the next year's selections. Furthermore, since the final criteria for selection in tobacco are the yield and quality of the cured leaf, it is of great importance that some idea of the curing qualities of the selected plants be obtained. These points were borne in mind in making all selections and records.

Measurements by themselves proved to be of little use as the differences within varieties are almost as great as differences between varieties. In one outstanding case two plants completely different in appearance when measured appeared almost identical on paper. Photographs were therefore combined with measurements. Two photographs being taken of each plant.

1. Photograph of mature plant in field.
2. Photograph of middle and top leaf removed from the plant and pinned out.

The middle leaf was selected in the following manner. It was noted that the leaves on nearly all the plants could be divided into two types. The bottom 7 to 10 leaves were of what may be described as typical type, the lamina being fairly broad in proportion to the length. The upper leaves were much narrower in proportion to their length, having somewhat strap like appearance. The transition between these two types of leaves in the middle of the plant is usually clear cut. In each case the top leaf of the typical type and the top reapable leaf were photographed. These photographs which were taken with a scale gave the following information without further recording.

Height of plant.
Height to any given leaf.
General habit of plant.
Spread.
Length and width at any point of middle leaf.
Length and width at any point of top leaf.
Distance up the plant at which leaves become of narrow type.
Width of ruffle of top or middle leaf.

These photographs gave a very accurate picture of the plant and brought out details, which in the field are not so obvious.

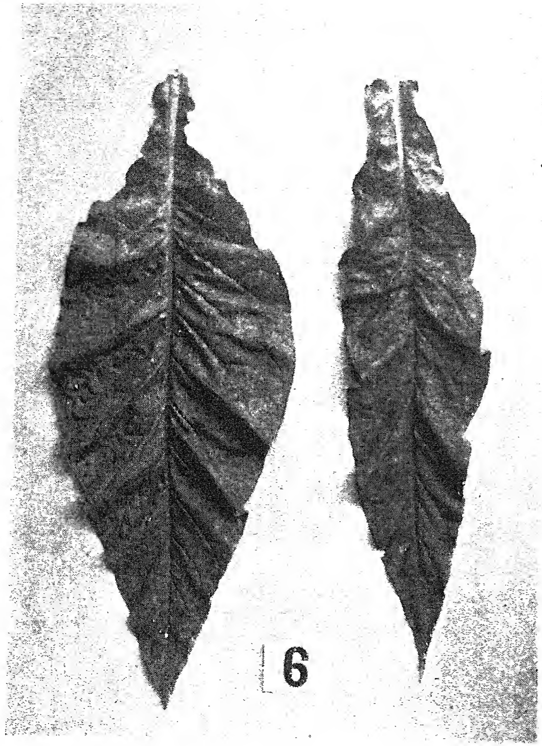


Fig. 2.—Eighth and sixteenth leaves from plant shown in fig. 1. showing narrow ruffle type.

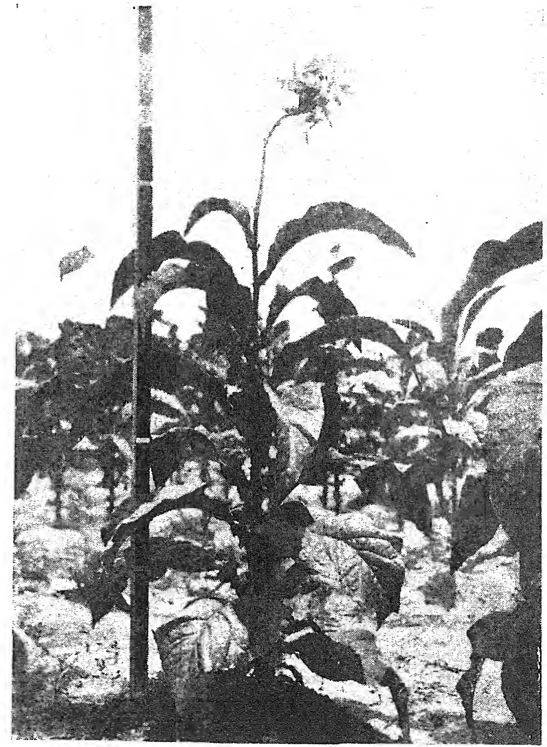


Fig. 1.—Jamaica wrapper, plant in field. Single plant selection by Dr. A. A. Moffett.

Curing Leaves from Selected Plants.—During the season this line of work was carried out more or less experimentally to see how far it would yield results and to what extent it could be used as a basis for selection. The leaves were reaped from each plant individually, each lot being tied on the stick and labelled immediately in the field. Individual bundles of leaves were then grouped together after curing so that all the cured leaves from any one plant were obtained. The single curings gave very interesting results as regards differences between texture, colour and tendency to sponge. One outstanding case occurred in Yellow Mammoth, a variety which sponged very easily. The leaves were reaped individually from three plants almost together in the row, and tied on the same stick. In two of these the cured leaves sponged badly, while the leaves from the middle plant were entirely free from sponging.

One of the chief objections to this method of selection is the fact that the plants have not been topped and the cured leaf may not be strictly comparable with that of plants grown under normal cultural conditions. To obviate this objection as far as possible the selected plants were rigorously suckered and the seed heads thinned down to a minimum; thus bringing the plants as near as possible to the "topped" condition.

It is too early yet to say whether these differences between the cured leaf from individual plants are heritable or not, but the following points may be put forward to show that it is probable that they are:—

1. Differences have been observed between the cured leaf of plants growing side by side or in close proximity in the field. It is improbable therefore that the differences can be accounted for by soil conditions.

2. Differences have been observed between leaves from individual plants cured side by side on the same stick. These differences cannot therefore be due to variation in curing conditions.

3. The differences between individual plants within a variety are of the same type as differences between varieties as regards sponging, texture, etc. The differences between varieties are known to have a

genetical basis, and it is probable therefore that the differences between individual plants within a variety are of the same order.

If the differences between individual plants within a variety do prove to be heritable, it forms a most promising line of investigation likely to yield valuable results and eventually to become a basis for all selection.

Types Selected.—The policy during the season was to concentrate on a few varieties which were known to be promising and to make several selections in each. For the first year diverse as well as standard types have been selected. Should any of these types prove to be valuable from the point of view of the cured leaf they can then be selected or crossed to obtain a good type of plant from the growth point of view.

The most obvious differences in types within a variety were bound up with ruffle size. These differences of ruffle were found to affect the whole plant and were closely correlated with distinctive differences in habit and leaf shape. They have therefore been studied fairly fully, especially as the wide "flaring" type of leaf is considered one of the faults of Rhodesian tobacco. The different ruffle types occur in several varieties, three types being distinguished as follows:—

1. *Narrow Ruffle Type.*—The ruffle is narrow in all leaves but is wider in the lower leaves than in the upper. The general habit of the plant is fairly tall, and the middle and lower leaves are wide in proportion to their length.

2. *Wide Ruffle Type.*—The ruffle in the lower leaves is almost as narrow as in type 1. In the upper leaves the ruffle becomes very wide, in extreme cases being up to 5 inches across. Plants with wide ruffle are always distinctive. The habit is shorter than type 1, the leaves are always longer and narrower. The leaf size is well maintained up the plant, the top leaves being almost as long as the lower. The leaf number is low. Apart from the ruffle the leaf shape in this type is good.

3. *Intermediate Ruffle Type.*—The ruffle in the lower leaves is approximately the same width as type 1. It becomes

wider in the upper leaves but not so wide as in type 2. The habit and the leaf shape of the plants are intermediate between type 1 and 2.

The wide ruffle is of interest inasmuch as it carries large leaves well up the plant, and does not "tail" off like the narrow ruffle type. The lower leaves are of good shape, not being too wide or flaring. Furthermore, the photographs of American or Canadian tobacco in Dr. Nierenstein's report, and in publications available, all appear to have the wide or intermediate type of ruffle. Further information on this would be of interest.

Varieties.—The following seven varieties which showed definite promise were studied in detail and curing records obtained. White Stem Orinoco, Jamaica Wrapper, Willow Leaf, Gold Dollar, Bonanza (Canada), Yellow Mammoth and Cash. Photographs of some of the types selected from these varieties have been kept for purposes of record.

Other Varieties.—Eight other varieties which did not show sufficient promise for single plants to be selected are being maintained for further observation. These have been mass selected, the seeds from four or five plants of a type being mixed. Varieties retained are:—

Bonanza, U.S.A.	Virginia Bright, U.S.A.
Cash, U.S.A.	Virginia Bright, Canada.
Jamaica, U.S.A.	Narrow Leaf Orinoco, Mauritius.
Moss Special, U.S.A.	Meadow Giant, Rhodesia.

Ambalema and Vumba are being retained for crossing.

Varieties Discarded.—Practically all the varieties imported last year have been discarded. The types from Mauritius and Brazil were obviously unsuited for cultivation in this country. The leaf was very bright lemon, thin and brittle. It would not take condition and dried out almost immediately after steaming. The varieties from Russia produced short broad leaves. They seemed very susceptible to disease and the cured leaf was harsh and brittle.

Varieties which have been grown two or more years and discarded this year are:—Adcock, U.S.A.; White Stem Orinoco, U.S.A. (this was not true white stem); White Stem

Willow Leaf, Canada; Willow Stem Orinoco, Canada; Warne, Canada; Yellow Pryor, Canada; and Hickory Pryor. The varieties have given consistently poor results.

Progeny from crosses.—Hickory Pryor x Warne and Hickory Pryor x Cash.

Progeny of these crosses produced very poor types. The leaf shape was either very wide like Hickory Pryor or narrow and strap like. From two reapings taken from these plots no good bright leaf was obtained, and in every case the leaf was very badly sponged. These crosses have been discarded as there seems no chance of selecting a good variety from them.

Crosses made during the Season.—A number of crosses were made between Ambalema and good varieties. Ambalema is resistant to mosaic disease, and it is hoped in the course of a few generations to transfer the resistance to other varieties.

Crosses were also made between varieties of proved value. These crosses are intended to produce greater variation in the initial stages and so give further material for selection.

Cytology.—It is suspected that some of the variations observed in tobacco varieties are not genetic but due to cytological abberations. A small number of varieties were examined and chromosome abberations of the type expected were observed. Unfortunately only a small amount of material was available by the time the laboratory was ready. It is proposed to make a further study of the cytology during the winter months to obtain information as to how far variability is genetic, whether different chromosome types can be obtained and weather the crosses made are likely to be sufficintly variable in the initial stages to yield results.

At Dr. Nierenstein's request the cytology of Yumba was examined. The variety has the normal chromosome number recorded in tobacco $2n=48$ and no outstanding abberations occurred during pollen formation.

Conclusions.—At the end of a single season's work it is quite impossible to arrive at any definite conclusions. However, from evidence obtained during the season from an examination of types in the field and of cured leaves of individual plants it may be concluded that:—

1. There are considerable variations as regards morphology (leaf shape, etc.) and curing properties among individual plants within a variety.

2. Some at least of these variations are genetic (inherent qualities of the plant) and not due to differences in soil and environmental conditions.

3. That by intensive selection on morphological characters and curing properties of the leaf over some generations it should be possible to obtain a more standardised and considerably improved strain or variety.

TOBACCO PLANT PHYSIOLOGY.

The Plant Physiologist, Mr. H. C. Thorpe, was appointed from England in 1935, so the season under review was the first occasion he had spent on tobacco work. As the subject is one which has never been investigated to any extent he had to decide first of all what criteria should be chosen and also how to interpret the results. The following notes are based on Mr. Thorpe's report.

Note on the Interpretation of Results.—All the experiments this year have been set out according to some form of modern field layout, from which statistical procedure renders it possible to assign a definite probability level to the results obtained. That is to say the exact part chance plays in the production of the figures can be stated with odds for or against. Chance may, in fact, play an enormous part in any experimental work; in field trials, for example, there are very large differences in the fertility of the soil in different areas. One treatment may be unlucky enough to strike a really bad piece of land, whilst another may be planted on an area of much higher fertility than the average. Not only soil, which is undoubtedly the most variable factor in field experiments, but many other causes such as uneven fertiliser distribution, unequal numbers of plants in the different plots, loss of leaves by disease; by dropping off in the barn, in the grading shed, etc., all help to increase the variability of the experimental material. Most of these causes, too, are beyond the control of the experimenter.

Because of these facts it is essential to obtain some idea of the amount chance plays in the production of the results. This may be done by a suitable method of field arrangement and arithmetical treatment of the results. From this it is possible to say that the probability of obtaining such figures by chance is ten to one against, fifty to one against, etc. For example, we may find that in a particular experiment the observed result will occur by chance once in five, or twenty, or a hundred, etc., trials. Even when the odds are as long as a million to one against we still cannot be absolutely certain that the figures obtained represent real treatment effects. Some limit has obviously got to be fixed; and is generally accepted that whenever the odds of arriving at any set figures by chance alone are twenty to one against the observed result shall be considered real. If preferred odds of a hundred to one against may be taken. By adopting this rule we cannot be right every time, in fact any conclusion drawn is bound to be wrong in 5 per cent. of the cases considered (or 1 per cent. if odds of a hundred to one are chosen), but we do know that we are likely to be right on an average 95 (or 99) times out of a hundred.

When the effect of the treatments has been shown to be real by the test described above (called the Z test by its originator) we may go further and by another test determine what part chance has played in the production of individual treatment differences. It is usual to work out a figure such that the odds of obtaining any differences between treatments greater than this figure by chance alone are, say, twenty to one or a hundred to one against. Thus, if, say, one hundred pounds of cured leaf per acre constituted a real difference at the five per cent. level ($P=.05$) and two treatments differed by, say, 110 pounds, we should be able to say that such a difference could only occur by chance on the average once in every twenty such experiments and that these two treatments were really different at the level of significance chosen.

This method is of great use, since real treatments effects are disentangled from the effects of pure chance and wrong conclusions avoided. The arithmetical working is often lengthy and complex so that only a plain statement of the results will be given.

Maturity.—The effect of any manurial treatment in hastening or delaying maturity may be gauged to some extent by its effect upon the development, as opposed to the growth of the plant. Within one variety, such as White Stem, it seems reasonable to suppose that those plants which flower earlier will also mature their leaves earlier. As a corollary of this it may be expected that treatments leading to earlier maturity will show a greater weight of green leaf at the first picking.

Accordingly it was decided to make notes on the flowering stage and use them as representing differences in maturity. Arbitrarily, five flowering stages may be distinguished:—

1. Flower bud just visible.
2. First petals visible.
3. Quite a number of open flowers; no pods set.
4. Plant in full flower, pods setting.
5. Plant past full flower, many pods set.

A single figure representing the stage of flower development of any single plot or treatment may thus be used. If these divisions are found unsatisfactory they may be modified in another season as thought fit.

Vigour.—Height measurements were taken as a measure of vigour. It does not necessarily follow that more vigorous plants will yield a product of a quality superior to that given by less strongly growing individuals, but they will be expected to give a greater weight of cured leaf. In all probability, too, treatments leading to increased vigour will, within certain limits, lead to greater financial returns per acre. It was decided to adopt as a convenient comparison the height of the plant at some arbitrarily fixed level such as the last leaf (defined as that leaf found at the base of the lowest leafless branch).

Grading.—The cured product was analysed into 27 grades, of which 15 were "bright" grades, 7 were "medium" and 3 were "dark" grades. One section was reserved for "short" leaf whilst into the final one was placed leaf which was considered below the standard accepted on the market.

The weight of discarded leaf has been included in the yield so that the weight of leaf per acre will be higher and the price per pound lower than if the discard had been omitted. The gross value per acre will, of course, be unaffected.

Tablet Fertiliser Experiments.—It is a generally accepted fact that tobacco of superior quality is obtained from plants which grow steadily throughout their life-history and suffer no severe check of any kind during this period. This regularity of growth, may in turn, well depend upon the readily available source of nitrogen sufficient to meet the needs of the plant at the various stages of its life. Thus any setback such as is given by prolonged drought, waterlogging for any length of time, leaching out of fertiliser constituents, etc., seems to be reflected in a lowering of the quality, as well as the yield, of the cured product, although the plant itself may, apparently, quite recover and continue to grow on, to external appearances at any rate, quite normally.

It was with this idea in mind that it was decided to see whether by holding back some portion of the nitrogenous constituent and applying it in small doses at intervals, the plant could be kept growing regularly and steadily throughout its life. Accordingly only a limited portion of the nitrogen was supplied at planting, the remainder being provided in tablet form throughout the season. By this means it was hoped that no setback due to lack of this element would occur whilst by keeping up a steady supply of this foodstuff a superior product would be obtained subsequently.

Experimental Procedure.—All plots received a basal dressing of 100 pounds 40 per cent. double supers, 27½ pounds sulphate of potash and 11 pounds muriate of potash, the amount of these constituents supplied in the normal application of 200 pounds per acre of fertiliser analysing 20—7—10. Only one-third of the total nitrogen was added to this mixture, that is, 4⅔ pounds as one-third organic and two-thirds inorganic, the remaining two-thirds was applied according to one of six methods:—

1. Applied as five weekly applications.
2. Applied as four applications, 1, 2, 3 and 5* weeks after planting out.
3. Applied as three applications, 1, 3 and 5 weeks after planting out.
4. Applied as two applications, 2 and 5 weeks after planting out.
5. Applied as one applicaion, 5 weeks after planting out.
6. Applied as considered necessary.

These six applications were tested both against one another and against a check consisting of 200 pounds per acre of a standard No. 4, a bloodmeal fertiliser, all applied prior to transplanting.

It is seen that further quantities of nitrogen are not applied beyond the sixth week (allowing one week for the plant to "settle down") after the plants have been set out in the fields. This was decided upon for two reasons (*a*) since it was considered fair that all treatments should receive their nitrogenous dressings within the same time; otherwise any results obtained might be explicable as differences in the times of completion of the nitrogenous applications, and (*b*) it was considered inadvisable to continue applications of nitrogen too near harvest on account of the danger of delayed ripening and the production of a coarse growth. Arbitrarily, five weeks was chosen as a convenient time in which to apply the remaining nitrogen.

Type of Fertiliser Tablet and Method of Application.—

Two entirely separate experiments were carried out:—

(*a*) The remaining nitrogen is applied purely as sulphate of ammonia.

(*b*) The remaining nitrogen is applied purely as nitrate of soda.

In both cases small tablets of the compressed salt were used, such that three tablets per plant were equal roughly to $1\frac{1}{4}$ pounds of nitrogen per acre.

*One week is allowed for the plants to settle down after being set out in the field; the experimental time is to date from the end of this period.

The tablets were applied in three small holes, roughly three inches deep, spaced equidistantly round the plant. This was accomplished most easily by a number of boys, each boy taking one row of plants and using a small stick with a cross piece three inches from the bottom. This ensures the holes being roughly of the same depth. A second small gang of boys coming behind applies the requisite number of tablets per hole which were then roughly closed.

All the plots were planted on January 10th and the number of tablets per plant in each case was 15. In his report Mr. Thorpe gives detailed particulars of all the plots, including yield per acre, discard percentage, price per lb., etc. It may be stressed that it is essential to repeat experiments of this nature for several seasons to eliminate, as far as possible, climatic effects, but Mr. Thorpe's conclusions, which follow, will be of interest as applied to the 1935-36 season.

Conclusion.—In all the cases considered in which part of the nitrogen is withheld from the plant at setting out and applied subsequently either as sodium nitrate or ammonium sulphate in tablet form there has been obtained a lower yield, a lower price per pound and a greatly decreased gross value per acre compared with areas which received an equivalent quantity of nitrogen in one dose prior to transplanting. These reduced values may be due partly to the impoverished stand resulting as an effect of the treatments, partly to the increased spread of the mosaic infection due to excessive handling and partly to other causes. The price, yield total value and proportion of bright leaf are decreased steadily as frequency of tablet application is increased, whilst the percentage of mosaic infection and the proportion of dark and discarded leaf is similarly increased. This year's results indicate that there is nothing to recommend fractional nitrogen application; in fact, the withholding of a portion of the nitrogen produced depressing effects in those factors which go to make up the commercial justification for the treatment—monetary returns per acre.

It must be borne in mind that the plants were not set out until very late in the season, and that given a favourable opportunity the response of fractional nitrogen application

may be quite different. At the same time the very real danger of the spread of mosaic infection due to assessing the value of such treatment.

The idea underlying the use of tablets as a method for fertiliser application seems rather open to question. Firstly, the actual area of ground receiving the dressing is very small so that an extremely concentrated solution of plant food would be produced in the area of the tablet. Secondly, it is very doubtful whether the plant roots in the immediate vicinity of the tablet would be able to absorb the concentrated solution; in fact, it is quite possible that under some circumstances the roots may actually be poisoned by the excess of food present. Furthermore, owing to the extreme localisation of the fertiliser and to the fact that only a very small proportion of the plant's entire feeding system can come into contact with the food given (since lateral spread in the soil is very small) it seems not unlikely that much of the available material may get washed away before it can be utilised. It would seem that a most satisfactory way of applying further quantities of fertiliser during the season, if considered necessary, would be as a top dressing spread round the plant. No local concentration of salts would take place, the complete root system, as opposed to a small portion of it, would be given the opportunity of accumulating the food.

REPORT OF COLOURED SEEDBED CLOTH ON YIELD AND QUALITY OF TOBACCO.

General.—It is the view of Dr. Nierenstein that the amount of ultra violet light received by the tobacco plant growing under Southern Rhodesian conditions is far in excess of that received in habitats where the crop is truly indigenous. This fact, he feels, may possibly cause the leaves to assume a more upright habit and a more acute angle with the stem to overcome this extra light. The effect of this would be to increase the midrib and possibly the smaller veins, both undesirable modifications on account of the reduction in value of the product and extra loss in the factory.

Quite apart from this increase in worthless material the effect of extra violet light upon the smoking properties and flavour of the leaf should not be lost sight of.

He suggests, therefore, that plants should be grown under conditions of increased ultra violet light in seedbeds which should have the effect of accustoming the plant whilst still in the seedling stage to conditions to be met with later in the field.

Method.—According to Dr. Nierenstein's suggestion the seedbed cloths dyed eight different shades were tested against the ordinary white cloth for any possible effects on the subsequent crop.

The seedbeds were constructed in 10 yard lengths and received the usual fertiliser dressing of 1 lb. per 5 yards of bed. The white cloth was employed in the usual manner of two thicknesses, but the coloured cloths were used in three thicknesses each in keeping with the analytical data supplied.

Sowing was effected on October 21st and germination, which appeared regular, took place one week later. The beds were thinned and sprayed and, in fact, treated in the normal routine fashion, except whereas one thickness of the white cloth was removed soon after germination as is customary the experimental seedlings remained under three thicknesses of coloured cloth.

It was soon noticed that the plants grown under routine conditions were in every way superior to those under the experimental cloths, which plants were considerably smaller and had very poorly developed root system. This tendency became increasingly apparent until at hardening off it was seen that the plants grown under the darkest cloths were, in fact, the most poorly grown out, both as regards size and root development. These plants also suffered more from cutworm attacks. Hardening off started on November 26th, 36 days after sowing, and planting out on December 15th, 8 weeks after sowing.

Due to the late planting rains both the check and experimental plants were larger than normal when actually set out in the field. It was noticeable that the treated plants which had been grown according to the conditions of the experiment under three thicknesses of cloth were appreciably weaker and more spindly than the controls. Measurements of the density

of the plants in the seedbeds showed no difference in the number of plants per unit area between the experimental beds and the check ones.

Fertiliser.—The land received 200 lbs. per acre of Double Complete just prior to planting.

Layout.—The experimental layout consisted of four randomised blocks with four replications. The plots were $\frac{1}{4}$ acre each, the land second year.

The details of each plot were given by Mr. Thorpe, whose conclusions may be summarised as follows:—

Conclusions.—Thus it is very obvious that not only have the coloured cloths failed to show any beneficial effects upon the plants grown under them but, on the contrary, by lowering both the yield and price per pound have led to greatly depressed monetary returns per acre. There seems no doubt that these values are real and represent real losses.

Moreover, apart from a general delay in flowering and height no differences were observed between the control and the treated plants, the habit of growth was the same in both cases.

Samples of leaf have been saved for analysis, although modern work has shown that the role of ultra violet light is of little or no consequence in the production of foodstuffs within the plant. From a strictly commercial point of view the experiment in its present form should be considered as finished.

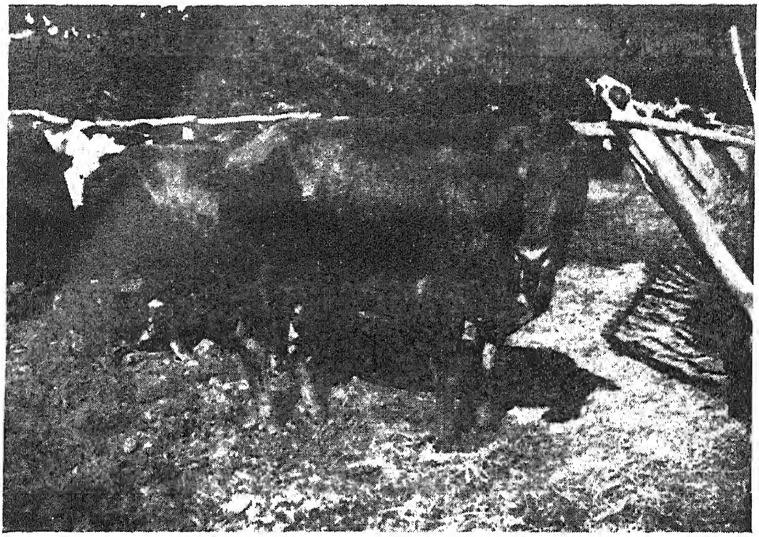
Lysimeter Experiment.—The idea underlying an experiment of this type is to find out at what times and in what quantities the various foodstuffs supplied in the fertiliser become available to the plant, and what is far more important is to determine the amounts of those elements lost to the crop by washing and leaching.

In the first instance it was decided to concentrate on the nitrogen in the fertilizer, since this is the element the most likely to be lost. Moreover, in sand veld areas, at any rate, where loss of fertiliser by leaching seems particularly prevalent, nitrogen tends to be the controlling factor in the crop production.

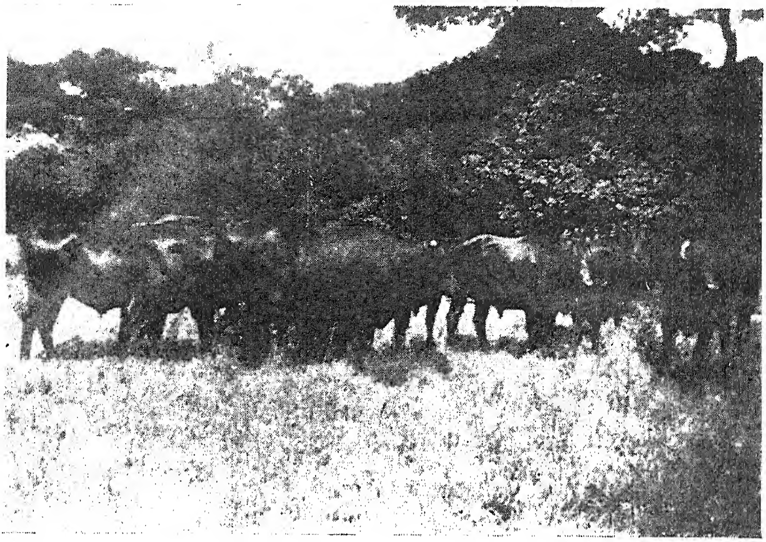
The apparatus used this season consisted of Winchester quart bottles equipped with funnels and containers to represent the sub-soil. Sixty such lysimeters were used, 30 for the fertilised ridges and thirty controls.

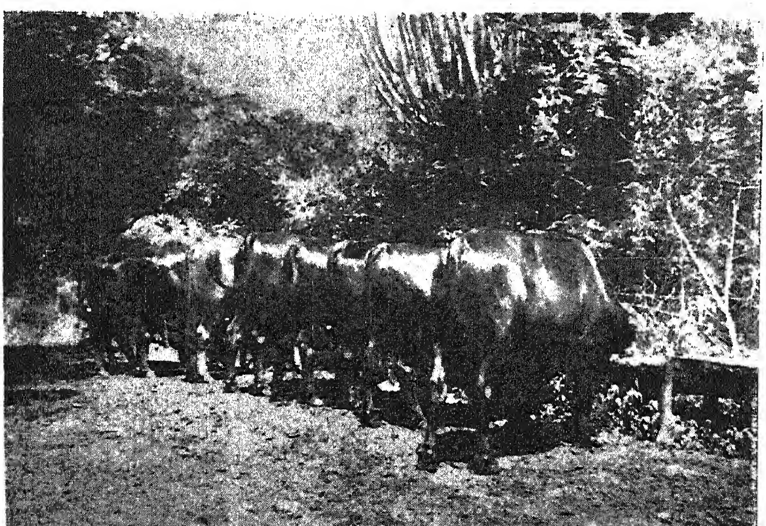
Samples of the soil from the containers were retained for analysis but no water reached the bottles, as the collecting funnels were probably too small. It is obvious that in future seasons funnels sufficiently wide to collect from the whole width of the ridge must be used.

(To be continued.)



2.—Shorthorn x Africander steers used in Trial II. in the feeding pens.





1.—Aberdeen Angus x Africander steers used in Trial I. Note the type of grazing and feeding camp used.

Comparative Feeding Value

OF MAIZE MEAL AND NYOUTI (*PENNISETUM TYPHOIDES*) MEAL FOR FATTENING STEERS.

C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate.

A. E. Romyn, Chief Animal Husbandry Officer.

SUMMARY.

Two trials were carried out to compare the feeding value of maize meal and nyouti meal for fattening steers.

In the first trial three similar groups of steers received concentrate rations of:—

Maize meal.

Maize meal and nyouti meal (unboiled).

Maize meal and nyouti meal (boiled)

respectively. Groundnut meal and blood meal were fed as protein supplements to all groups.

In the second trial two similar groups of steers received maize meal plus bloodmeal and nyouti meal plus bloodmeal respectively.

In both trials all the steers did well and made good and economic gains.

The result of these trials indicate that nyouti meal is possibly five to ten per cent. more valuable than maize meal for feeding bullocks.

DESCRIPTION OF THE EXPERIMENT.

Two feeding trials were carried out at the Matopo School of Agriculture and Experiment Station in 1933-34 and 1935 respectively. In each trial the steers were fed for a period in pens and for a period, while the grazing was good, on the grass.

Large quantities of nyouti are grown by natives in this Colony. Of recent years the use of this grain has become increasingly popular among European farmers for the feeding of all types of stock as an alternative feed to maize, where the grain has to be purchased. The present experiment was carried out to compare the value of maize meal and nyouti meal for the fattening of steers.

Nyouti is somewhat higher than maize in crude protein but otherwise the two feeds are similar in composition. Average analyses as determined by the Division of Chemistry are given below:—

	Nyouti.	Maize (dent).
	%	%
Moisture	9.42	7.0
Ash	2.18	1.3
Crude Protein	11.37	9.4
Ether Extract	4.31	4.5
Fibre	1.57	1.9
Carbohydrates	71.15	75.9

TRIAL I.: 1933/1934.

Cattle Used.—Fifty-eight approximately five-year-old grade Aberdeen Angus steers were divided as evenly as possible, as regards age, weight and conformation, into three groups of 19, 20 and 19 steers respectively. The steers had been purchased in the Gwanda district and were allowed to acclimatise at the Station for a short while before the experiment was started.

Trial I. commenced on the 12th November, 1933, and terminated on the 9th February, 1934, a period of 89 days. During the first 55 days the steers were fed in pens with approximately 10 bullocks in each pen. After the start of the rains the pens became too wet for the comfort of the cattle.

Moreover, by this time the veld grass had become good and the steers became restless. They were therefore turned out on grass and fed their concentrate ration as a supplement to the grazing for the remainder of the feeding period until ready for slaughter.

Rations Fed.—The different groups were fed as follows:—

(*a*) *Concentrates.*—

Group I.—Maize meal, peanut meal, bloodmeal.

Group II.—Maize meal, nyouti meal (unboiled), peanut meal, bloodmeal.

Group III.—Maize meal, nyouti meal (boiled), peanut meal, bloodmeal.

All groups received the same quantity of concentrates—approximately 12½ lbs.—per head per day. Maize meal and nyouti were fed in equal proportions by weight to Groups II. and III. As a number of feeders hold that nyouti should be boiled before feeding, the nyouti meal fed to Group III. was boiled and then mixed with the maize meal to determine the effect of boiling on the feeding value of nyouti.

(*b*) *Roughages.*—While the steers were in pens they received a full roughage ration of veld hay plus a very small allowance of maize silage for succulence. No further roughage was fed when the cattle were turned out to grass.

The steers were weighed periodically and marketed at the Rhodesian Export and Cold Storage Company for export as chillers when fat. Care was taken that the same number of steers from each group was despatched in each of the periodic drafts to the works. The carcases were graded after slaughter.

Particulars of the rations fed, feed consumption, rate of gain of the steers in Trial I. and a statistical analysis of the results are given in Table I.

TABLE I.

Rate of Gain and Feed Consumption of Steers in Trial I.

	GROUP I.	GROUP II.	GROUP III.
No. of steers	19	20	19
Average age	± 5 years	± 5 years	± 5 years
Breeding	A.A. Grades.	A.A. Grades.	A.A. Grades.
No. of days fed	89	89	89
Average initial weight per steer	1,002 lbs.	992 lbs.	998 lbs.
Average final weight per steer	1,212 lbs.	1,216 lbs.	1,226 lbs.
Average total gain per steer	210 lbs.	224 lbs.	228 lbs.
Average daily gain per steer	2.34 lbs.	2.54 lbs.	2.58 lbs.
Average cold dressed weight	644 lbs.	650 lbs.	645 lbs.
Average dressing, percentage	53.2%	53.5%	52.6%
Finish of steers	No	difference between the three	groups.

Feed Consumption.	Group I. Average Per steer per day.	Group I. Average Total per steer.	Group I. Average Total per group	Group II. Average Per steer per day.	Group II. Average Total per steer.	Group II. Average Total per group	Group III. Average Per steer per day.	Group III. Average Total per steer.	Group III. Average Total per group
Roughage—									
lbs. veld hay	15.4*	849	16,125	15.6*	854	17,086	15.6*	855	16,249
lbs. maize silage	.8*	44	840	.8*	42	840	.8*	44	840
Grazing days		34			34			34	
Concentrates—									
lbs. maize meal	11.4	1,010	19,194	5.6	496	9,922	5.4	481	9,144
lbs. nyouti meal	—	—	—	5.6	496	9,922	5.4	481	9,144
lbs. peanut meal	.90	81	1,538	.88	78	1,549	.88	77	1,453
lbs. bloodmeal	.30	27	512	.29	26	517	.29	26	486
lbs. bonemeal	.12	11	205	.11	10	207	.11	10	193
lbs. salt	.06	5	102	.06	5	104	.06	5	98
Total Concentrates	12.8	1,134	21,551	12.5	1,111	22,221	12.1	1,080	20,518
Feed consumption per 100 lbs. gain in live weight.									
Hay ... lbs.		400†			381†			375†	
Silage ... lbs.		21†			19†			19†	
Concentrates ... lbs.		535			495			473	

*Av. per day for period fed in pens.

†Calculated for whole period, including time in pens.

Statistical Analyses of Average Daily Gains.

	Group I.	Group II.	Group III.
No. of animals...	19	20	19
Average daily gain ...	2.34	2.54	2.58
S.D.	.447	.520	.729
C.V.	19%	20.5%	28.3%
S.E. mean	±.103	±.116	±.167
	Groups I. and II.	Groups II. and III.	Groups I. and III.
Diff. between means	.2	.04	.24
S.E.	±.155	±.203	±.196
"t"	1.29	.197	.123
P...	.2—.3	.8—.9	.2—.3
Significance	Not significant.	Not significant.	Not significant.

TRIAL II. : 1935.

In the second trial the nyouti meal was not boiled and the maize meal and nyouti meal were fed separately, not mixed as in Trial I.

The trial was commenced on the 23rd of February, 1935, and terminated on the 27th May, 1936, a period of 93 days. In this case the experiment was started when the steers were on the grass. After a period of 36 days, when the veld grass had become too mature and dry for rapid gains, the steers were put into the same pens as used in Trial I. for finishing. Similar data were obtained in regard to the rate of gain, feed consumption, carcase qualities, etc., as in Trial I.

Cattle Used.—Thirty-eight grade Shorthorn and grade Africander steers, approximately four years of age and of good beef type were used in this trial. They were divided into two even groups as regards weight, breed and conformation. The cattle were purchased locally, but had to be confined in pens for a short while before the experiment started to teach them to consume grain. As soon as the cattle were feeding freely they were turned out on the grass and the trial was started.

Rations Fed.—

(*a*) *Concentrates.*

Group I. received maize meal and bloodmeal.

Group II. received nyouti meal and bloodmeal.

No bonemeal and salt were used in this experiment. Both groups received an average ration of 10 lbs. of concentrates per head per day.

(b) *Roughages.*—For the period when they were penned each group received the same amount of veld hay and maize silage.

Particulars of the ration fed, the feed consumption and the rate of gain of the steers in Trial II. are given in Table II.

TABLE II.

Rate of Gain and Feed Consumption of Steers: Trial II.

	GROUP I.			GROUP II.		
No. of steers		19			19	
Average age		4 years.			4 years.	
Breeding		Gr. Shorthorn & Africander			Gr. Shorthorn & Africander	
No. of days fed		93			93	
Average initial weight per steer		929 lbs.			933 lbs.	
Average final weight per steer		1,177 lbs.			1,197 lbs.	
Average total gain per steer		248 lbs.			264 lbs.	
Average daily gain per steer		2.7 lbs.			2.8 lbs.	
Average cold dressed weight		597 lbs.			614 lbs.	
Average dressing, percentage		50.7			51.2	
Finish of steers			No difference.			
Feed Consumption.	Average Per steer per day.	Average Total per steer.	Average Total per group	Average Per steer per day.	Average Total per steer.	Average Total per group
Roughage—						
lbs. veld hay	14.6*	812	15,430	14.0*	781	14,830
lbs. maize silage	16.0*	890	16,918	16.0*	890	16,918
Grazing days		36			36	
Concentrates—						
Maize meal	9.9	919	17,475			
Nyouti meal				10.0	930	17,680
Bloodmeal	0.3	26	493	0.3	25	483
Total Concentrates	10.2	945	17,968	10.3	955	18,163
Feed consumption per 100 lbs. gain in live weight.						
Hay ... lbs.		329†			290†	
Silage ... lbs.		351†			329†	
Concentrates ... lbs.		381†			362†	

†Calculated on gains made during whole feeding period including time on grass.
*Average per day for period in pens only.

DISCUSSION OF RESULTS.

Trial I.—The steers took readily to the rations and all three groups did well. Groups II. and III. receiving nyouti meal did slightly better than Group I. receiving maize meal. The difference in the daily rate of gain of .2 to .24 lbs. between the maize fed group and that of the two nyouti fed groups is too small, however, to enable a definite conclusion to be drawn as to the comparative feeding values of the feeds. Groups II. and III. also showed a slightly more economical feed consumption than Group I. on maize meal, but here again the difference is considered too small to be attributable to the ration alone and is probably due in part to a difference in individuality between the groups.

No apparent advantage was gained from boiling the nyouti. The boiled nyouti seemed less palatable than the unboiled meal and was less convenient to use. Boiled nyouti was not used again in Trial II.

There was no difference between the carcases in the three groups after slaughter. Eighty-five per cent. of the carcases graded very good in each group.

Trial II.—Both groups of steers again did well. The nyouti fed group again made slightly better and more economical gains than the maize fed group. The difference, however, is again too small to allow definite conclusions to be drawn. All the carcases in both groups graded "Imperial," which is the top grade for export.

Conclusion.—In these trials nyouti meal proved fully equal to maize meal, both when used to replace half or all of the maize meal in the grain ration.

The slight differences in rate of gain and feed consumption per unit of gain in both trials were in favour of the nyouti meal, and though too small to be considered significant, suggest that the nyouti is a slightly more valuable feed possibly than maize for fattening bullocks.

Bee-Keeping in Rhodesia.

By T. W. Savory, Monze, Northern Rhodesia.

PART II.

A very useful addition to any hive is an entrance closer such as was illustrated in Part I., which runs in one piece through the entrance, but instead of being of wood throughout has about 5 inches in the middle filled in with fine wire screen. This is to be used when, for sundry reasons, the hive has to be closed for a short while, such as moving it if required, to stop robbing, or other reason. To close it altogether with a wooden closer might frighten the inmates, who are always very concerned when once they find themselves closed in with all air shut out. Such a closer can be made in a few minutes and should be marked with the number of the hive so as to know at once which hive it will fit exactly.

Swarms and Colonies.—The terms swarms and colonies have altogether different meanings. A swarm is a large collection of bees that has left its old home in charge of a queen (new or old) for a new one, the main reason being that the old home has grown congested so that more room is wanted for expansion. As soon, however, as the scouts that have been sent out have located new quarters and the swarm has taken possession of it, it is then known as a colony. Such a new colony settles down very quickly and starts building and egg-laying within a very short time.

Full details of the actual swarming and its causes will be given in another article, suffice it is to say now, to quote Mr. Attridge in his "Bee Keeping in South Africa," "the time of the year that bees swarm in South Africa may be said to cover the whole calender and is governed largely by locality and climatic influence." This the writer has found to be strictly the case, though perhaps in the Rhodesias the season for it is mainly confined to the latter end of summer and autumn, but our climatic conditions do influence the times for swarming considerably.

Hiving a Swarm.—Taking for granted that the instructions on hives in the last article have been duly carried out and that all is ready for the coming inmates, have the following articles ready for use: a good veil, smoker, pair of gloves, a fairly large kitchen spoon, a bee brush, one or two cloths of old linen a trifle larger than brood chamber surface and an old square dish about 12 to 14 inches to be used for brushing clusters of bees into on occasions (a bread baking pan suits exactly). Add to these items a carrier made of light wood. Two pieces of $1\frac{1}{2}$ by 3 boarded over with three-ply a little wider than the hive will serve this purpose. It is to place the newly swarmed hive upon at sundown to carry it direct to the apiary. All being ready a good lookout for what are known as bee scouts should be made; these are workers from the hive or nest that is being deserted and they are sent out as a rule in the early morning to find a new home. They may be recognised as a few odd bees flying about a workshop, garage, or other building, outhouse, cupboard, bedroom or anywhere else that may take their fancy as a likely home. Something which has held bees before is greatly favoured, and for this reason it is often possible to get scouts to adopt an old hive if suitable arrangements are made beforehand. From the way in which the scouts work it can usually be told whether they are in earnest or are only a few roving insects in search of food. Should they remain in one place after a short while and bustle in and out of any box or receptacle lying about it may be accepted that they are searching for a new home. If, moreover, some go inside and start closing up any holes with propolis or bee glue, the fact may be taken for certain. In this case place in the old hive chosen a few brood frames with full foundation and then fill up with dummy frames of wood and cover up with the lid again. Here it may be said with advantage that the beeman should never be persuaded to make his frames of strips of foundation wax only instead of whole sheets, as is often done, or at least advocated by some. It is a false way of starting, for although three inch strips may save a few shillings on a few hives, a great deal of time is lost by the bees at a time when every assistance should be given them by their owners. Often in twenty-four hours the workers will have drawn out enough complete comb to allow the queen to begin egg-laying.

Have the hive all ready, the quilt rolled off the frames a little and the lid wedged open a trifle at one corner just enough to allow bees to enter. The main body of bees should appear about 3 to 4 p.m. With a steady flight the whole swarm of from 20 to 60 thousand bees will swoop down close to the place chosen after hovering in the air above it for a few seconds, and within a few minutes will have entered the ready hive chosen by the scouts. As soon as all the bees have entered and all is quiet take off the lid and, drawing the quilt carefully to one side, slip in more of the ready frames according to the strength of the swarm. A full sized swarm can easily utilise all the ten frames straight away, while a smaller one may only want a few, in which case the spaces should be filled up with dummy frames. This matter is important, for if the inside of the brood chamber is not properly filled the hive will be cold and the bees will probably soon desert it.

As a rule these volunteer swarms are quite safe to handle, even without protection, for the simple reason that before leaving their former hive they filled themselves with honey, in which condition they are happy and good tempered and do not sting. As, however, it sometimes happens that the swarm may have been waiting for some time on account of bad weather or have been driven out of its hive by natives and is therefore hungry and cross, it is therefore never really safe to risk handling a swarm without having a veil and other necessities ready at hand if wanted.

Having now got the swarm safely inside their new home there is nothing more to be done just at the moment, so after seeing that the quilt is replaced, also the lid, let the hive alone for a while. Some beemen place a strip of queen excluding zinc over the entrance, secured in its place by the entrance closers. This is to prevent the queen escaping and so losing the whole colony. The writer does not advocate this practice, for while it is perfectly true that with this excluder the queen cannot possibly escape, it is almost an unfailing rule that once the bees have accepted their home they will not forsake it for another.

Swarms are most often captured away from the apiary, and when this is the case the hive containing the new swarms should be left until about sundown. Then slide the closer

into position, place the hive on the carrier mentioned, tie it down so that it will not fall off and carry it to the apiary or place decided upon for it to stand. During this operation the hive must be handled gently and carefully not to upset the bees unduly or they may leave the hive again the next morning.

Having at last placed the hive on its stand all that remains to be done is to put the roof on and to fix a few green twigs on top to guide the bees to their new home when they first return. They are very observant little insects, and on leaving a strange hive take careful note of the immediate surroundings and the presence of the twigs will readily distinguish the hive.

This method of housing a swarm direct into the hive is not always possible, for the scouts will sometimes persist in choosing their own domicile and take possession of a trap or box. Should this be the case, as soon as the bees have settled down quietly, say, in an hour or less, place the box gently on a table level with the hive chosen and lift up the box lid carefully. Should there be any bees clustering on it, as is usually the case, shake them off into the hive or brush them off with a bee brush. Then remove the frames which had been placed in the trap or box one by one, carefully dropping each into its place in the hive when it will generally be found that the whole swarm has been successfully transferred. As quickly as possible, though still gently, fill up the hive exactly as described before with perhaps in this case a strip of queen excluder in front if this is thought to be advisable. Should neither of these places have been chosen by the bees but instead an old cupboard, box or other receptacle, open it quietly and having a hive ready as described take the pan or dish referred to earlier, and holding it underneath the cluster, brush the bees off into the pan or dish, emptying the mass directly into the prepared hive. Repeat this action until all or the greater portion of the swarm has been so dealt with and then complete the operation as described above. In this case it will be wiser to use the queen excluder for a day or so.

The only other method that need be mentioned here is the case of a swarm that cannot be well emptied into the

top of the hive. This is known as the run in system and is as follows:—Place the hive to be used in a position some distance above the ground and from the level of the entrance place a frame of boarding the width of the hive and about three feet in length. Take the box or receptacle in which the bees are, gently open the top and shake the bees out on to the board, taking care that the queen is not injured in the operation. If she is to be seen gently guide her up to the hive entrance and see her actually inside when all the other bees will run in after her, and in a minute or two they will be all safely hived. After this is done proceed as described earlier. If this plan is adopted as soon as the swarm has taken up its first quarters it will be found to be a simple matter and one that is practically always successful.

In these methods of hiving swarms care should be taken to make sure that there are no open spaces left in the brood chamber, for if there are the bees will build their comb on to the quilt, which will mean that when opening out the brood chamber later on, even if only left for a few hours, the tearing off of the quilt will not only enrage the inmates, and probably bring them out in thousands, but the comb is likely as not to fall into the bottom of the chamber. There is then the risk of blocking up the entrance and suffocating all inside; while if no quilt is used the comb will be built on the lid, which is a much worse condition. The writer has experienced both cases and has proved that ten to twenty dummy frames laid by for possible use are of much real value.

There are other methods of hiving bees, such as from under floors, in roofs, inside walls of houses, etc., which, if space permits, will be dealt with later, but these are very messy operations. They always result in great loss of bees, the queen is frequently lost and the probability of failure is so great that it is hardly worth the trouble.

The Growth, Welfare and Handling of the Colonies.—Before dealing further with a recently formed colony the owner should make him or herself acquainted with the natural history of the honey bee, a knowledge which will be of much use in all apiary work.

At the height of the season of activity, *i.e.*, in the early part of summer, there are three kinds of individuals in a normal colony: (*a*) The queen; (*b*) thousands of worker-bees; (*c*) many drones.

The queen is the largest individual of the colony, longer and more slender than the drone or worker, with wings only half the length of the abdomen, and legs longer and firmer than those of the worker and without pollen pockets. The queen possesses a small ovipositor or egglayer, and it may function as a sting. It is very rarely used on man, however, and its use is reserved for killing rival queens. The queen is a full developed female and is the mother of all the bees in the hive (except just after a new queen has been reared). Her only duty is the laying of eggs. Eggs are laid at the bottom of the cells of the comb, in that portion of the nest devoted to the rearing of broods. The number of eggs laid in a day is about 1,500 to 2,000 at the height of the egg laying season.

The queen normally mates but once, *i.e.*, when the virgin queen is 5—6 days old. She leaves the hive on what is known as her wedding flight and is followed by drones. Mating takes place high up in the air and the queen returns to the hive and does not leave it again, unless with a swarm, and settles down to egg laying after about two days. The average life of a queen is 3—4 years.

The majority of the bees in the colony are worker-females, whose sexual organs are undeveloped and whose bodily structure has been adapted for special duties in the colony in other ways. Worker-bees are smaller than the queen; their hind legs are flattened and fashioned into pollen baskets; they have wax glands on the underside of the abdomen, from which wax is secreted in flakes; the sting is straight and barbed, and the workers possess well developed honey stomachs and the front legs bear combs for cleaning the antennae. They are indeed the Cinderellas of the hive and are wonderfully adapted to do all the work. The workers feed the larvae or immature stages, care for the queen and drones, clear, ventilate and defend the hive; secrete wax and build comb, collect nectar, pollen, water and propolis and convert the nectar into honey. The length of life is determined by the amount of

work which they do. During the so-called honey-flow, the busy seasons of the bee and the time when nectar is gathered abundantly, worker bees live for six weeks on the average. Workers born just before or during the nectar season live much longer than six weeks. Most of the workers die in harness out in the field, really game to the last and unable to bring home their last load. Normally the workers do everything in the hive except lay eggs, but it has been established, apparently, that workers of the South African bees can, under certain conditions, produce "worker" queens capable of carrying on a colony until a real queen is produced.

The Drones.—The drone is the male bee and does no work at all. His one and only purpose in life is to mate with and fertilise the queen, and in this act he dies. He is larger and stouter than the worker; he has no sting and is useless for the defence of the hive. After brood-rearing begins in the spring, workers are first reared, but drones soon appear so that numbers may be present to fertilise any virgin queens reared. At the end of the honey flow, when the services of the drones are no longer required, they are turned out of the hive to die.

Brood.—In a thriving colony of bees, in addition to the three kinds mentioned, there are present during the busy season immature bees in all stages of development—eggs, larvae and pupae—together termed brood.

An essential feature of all places where bees live, whether in hollow trees or hives, is its suitability for the building of comb, which consists of many six-sided cells in a vertical layer. Cells are made of wax, a material produced by the [redacted] secreted in flakes on certain wax plates situated on the underside of the abdomen of the worker-bees. It is estimated that the bees consume 20 lbs. of honey to enable them to produce 1 lb. of wax. In these cells the developing workers and drones are reared, while they also serve as a storing place for honey and pollen. The cells in which drones are reared are larger than those for worker-bees, while for rearing queens special large cells are constructed. Honey is usually stored in the wider cells and pollen in the smaller ones.

(*To be continued.*)

Successful Witchweed Control.

(Continued.)

BY RHODESIAN FARMERS.

REPORT No. 11.

By Mr. W. Sole, Bauhinia, Glendale.

Storm-drains are necessary above all maize lands to prevent witchweed seed from being introduced from veld or other sources; incidentally maize yields are improved by preventing storm-water running over the land. We have found on this farm that it is quite practical to keep witchweed under control by hand cultivation; we find it necessary every season to have a good sized gang of natives with badzas working systematically through all maize lands, whether badly or lightly infested. The boys hoe deeply at the roots of witchweed plants regardless of maize roots, they gather and put into sacks all witchweed whether seeded or not. The plants are buried in a pit. We have not found it necessary to trap-crop, as we have controlled by badza before the lands became too badly infested.

Costs.—We average nine boys per 100 acres maize for witchweed control from the beginning of February to the middle of May.

Editorial Note.—The fact that Mr. Sole's average yield of maize was over 18 bags per acre last year and promises to be the same this season is strong evidence of his success in controlling witchweed by hand hoeing.

REPORT No. 12.

By a farmer in the Salisbury District.

I am in receipt of your letter of the 9th inst., and the following is a brief account of my experience in controlling witchweed:—

I have had witchweed in my lands to my knowledge for the last seven years, but have been able to keep it well in hand by hoeing; in fact, if I grow mealies for 3 (three) years in succession in the same land the pest is practically eradicated. I find that witchweed is at its worst following green-manuring, due to the fineness of the soil which aids germination. Storm-drains are most essential and contour ridging is also a great help in protecting the lands from reinfestation. Hand cultivation is the only method used here and has been quite successful, but constant supervision of the natives is necessary during the whole period. I should like to add a note of warning here. Ordinary sacks should never be used to carry off the weeds which are in flower. Tins or canvas holders should always be used. It is better to dig out the pest and leave it rather than carry it off in ordinary sacks if seed has set. I have had no experience of trap-cropping, as I have not allowed my lands to get badly infested. From my own experience I would advise the following:—

1. Better methods of farming.
2. Decrease of acreage of maize.
3. More side crops, mainly for farm use (cattle feeds).
4. More kraal manure.
5. Constant supervision of native labour.

If the above methods were more general in this country, witchweed and other worries—financial included—would eventually disappear.

Editorial Note.—This gentleman, who is one of our most successful farmers, offers very sound advice which might well be followed by his fellow-farmers.

REPORT No. 13.

By Mr. M. M. McCall, Ardura, Glendale.

I am afraid I shall not be able to give you any useful details on the eradication of the above. I have been digging it out to the depth of about 12 inches now for the last six or

seven years and I had not a bad patch on the farm this year, only scattered plants, which I destroyed. *Other methods may be better and less costly, but I have beaten it with the badza where three years ago it was actually killing the mealies.* I may suffer a bit next year because I was growing tobacco this year for the first time and boys were taken off twice a week to fill barns when last year they were on witchweed all the time.

Editorial Note.—Seven years ago Mr. McCall's farm was severely infested with the parasite as we can personally vouch. His careful supervision of the hand-hoeing has been the chief factor in his success in controlling it.

REPORT No. 14.

By H. R. E. Chamney, Kilmer, Glendale.

With reference to your letter dated July 9th, asking for my experience with witchweed control.

Whilst I have had witchweed on Kilmer for a number of years, I regret that I did not tackle it really seriously until last year, apart from experimenting on small sized lands. Nevertheless the results from these plots have shown me that you are quite right in the advice you have given, at any rate, as far as hand cultivation goes. I estimate that it will take me about 4 to 5 years to get my worst infested lands comparatively free from it.

With regard to trap-cropping, this last year is the first that I have trap-cropped. I ploughed under a seven-week-old crop of amber cane and replanted it to amber cane; this last crop was not ploughed under for eight weeks owing to different causes. When the last crop was being ploughed under I gave a dressing of 200 lbs. per acre of a complete fertiliser. Any witchweed which flowered was removed by hand. The results of this treatment will be reported when available.

Re storm-drains, I regret my information is not conclusive as far as results on yields go, as though all my lands are ridged and drained I put down the greatly increased yield to other causes, rotation and fertiliser, etc. A 40-acre land which has been ridged and treated with manure (one dressing) partly and green-cropped the rest, has increased in yield from 3 bags to 14 bags an acre. Also, witchweed was removed by hand three times in each year on this plot; there is very little remaining.

This last year I went through my lands six times and intend to continue doing this until I find it unnecessary any more.

With reference to your remarks on "pessimism," you are being mild. *There are several good farmers round here who have got on with it without making a fuss, and have practically cleared their lands of it.* Their example seems good to me and worth following.

Editorial Note.—Mr. Chamney's remarks regarding his neighbours' success are of particular interest.

REPORT No. 15.

By Mr. C. J. Campbell, Gatooma.

In 1933 one of our lands of about 200 acres gave us a yield of less than 4 bags per acre. After the maize had been cleared off the land it looked scarlet with the witchweed in bloom. We appealed to the Agricultural Department and they kindly sent down an Agriculturist, who strongly recommended us to put this land, in the coming season, to a double crop of amber cane and try to eradicate the witchweed.

This was done and the first ploughing started six weeks after the seed germinated, and another lot of seed was planted. Unfortunately the rains prevented us from getting the whole of the acreage ploughed under in time to prevent some of the witchweed seeding, with the result that we could not expect to have the land free of our troubles.

However, next season this land was put once more under maize and a good stand was obtained. About six weeks after the germination took place the maize took on a pale yellow appearance, which indicated that the soil had turned sour. This was obviously due to the amber cane not having rotted down thoroughly enough after the last ploughing, and more especially was this noticeable on the last section of ploughed land. A dressing of 200 lbs. super was given in between the rows and the maize recovered and yielded 8 bags per acre.

During the season only a very few small patches of witchweed could be found in this land, and mostly at the end of the lands, which indicated that the seed had been washed there and allowed to accumulate. Since then we have put "contours" through this land and a great improvement has taken place.

This last season, although we had a bad start, we have secured a good crop from it, but as it has not yet been reaped we cannot say what the yield is likely to be, but it gives the appearance of being better than last season's, despite the bad opening rains.

We have also made particular note of other lands to see whether there was anything in the idea that witchweed seed was washed to the low-lying parts of the land and was buried with the resultant silt, with the result that when next year's ploughing took place it was brought back to the surface and once more seeded down, and we have ample evidence that this is so.

To obviate this we are putting in further contours so as to reduce the wash to the lowest possible point, and we feel that we are on the right road to eliminate witchweed altogether from our lands, and as we have over 2,000 acres under cultivation it will be realised that this means a big thing to us.

In the writer's mind there is only one way to eliminate witchweed once it has got a firm hold, and that is to plant amber cane or other good traps and get it ploughed under

twice in the one season. This, of course, all depends upon the season, but should the second crop not be rotted down in time then we think it would be advisable to give the land a dressing of basic slag in place of supers. This we are trying out this season and we have every reason to believe that it will be successful.

Another snag we have discovered is the volunteer growth of amber cane, which must be exterminted as early as possible, otherwise the witchweed grows on it, and distributes seed, which may undo the work of the amber cane that has been ploughed under.

Editorial Note.—Mr. Campbell's opinion on trap-cropping as a method of control is of great interest, since he has made it his regular practice for a number of years past, and every year a large acreage is trapped with amber cane.

Southern Rhodesia Weather Bureau.

FEBRUARY, 1937.

Pressure.—The monthly mean pressure was generally low over the whole country.

Temperatures.—Monthly mean temperatures were about normal, the range was small as low maxima and high minima prevailed.

Weather Features.—The month as a whole was wet, the average number of rain days at the telegraphic stations being 17. The number of heavy falls reported was also high, and floods occurred in many districts.

A rainy spell had begun towards the ends of January, but pressure rose during the first three days of February owing to an easterly current from the Indian Ocean. Weather cleared somewhat on the 3rd, but showers were reported daily on the 3rd, 4th and 5th.

Pressure fell steadily from the 4th to the 12th. Thunderstorms developed on the 6th and 7th. From the 8th to 14th the country was under the influence of a well developed equatorial low, whose centre actually travelled up our western border during the last few days of the period. Rain was general, and heavy falls occurred daily in various parts.

With the rise of pressure a wedge of high formed over Southern Rhodesia, but a trough remained over the Zambesi Valley, connecting the equatorial low to a low over the Mozambique Channel. Steady east to south-east winds blew over the south, and although weather remained dull, little

rain fell. In the north and west, however, unsettled conditions continued, and considerable amounts of rain fell each day.

On the 19th a deep southerly low followed closely by a high again brought on general rains which lasted until the 21st. During the remainder of the month the country was in the track of an easterly current, and apart from a heavy rain in the Mazoe Valley on the 23rd, nothing but scattered showers were reported.

The total rainfall from telegraphic stations was 8.7 inches, 3 inches above normal, the excess occurring in most areas except Hartley and the east and south-east, which received about the average. The seasonal total over the whole country at the end of February was 1.5 inches above normal.

FEBRUARY 1937.

Station.	Pressure Millibars, 8.30 a.m. Mean.	Normal.	Temperature in Stevenson Screen °F. Absolute. Max.	Min.	Mean. Max.	Min.	½ Max. Min.	Normal.	Dry Bulb.	Wet Bulb.	Rel. Hum. %	Dew Point F.	Cloud Amt. 0-10	Precipitation. Ins.	Normal	No. of Days	Altitude (Feet)
Angus Ranch... ...	...	...	92	64	84.1	68.9	76.5	76.4	77.5	71.6	75	69	...	9.28	4.05	10	...
Beitbridge...	961.4	...	101	65	86.9	70.5	78.7	...	76.3	70.7	77	68	6.9	4.28	1.65	13	1,500
Bindura...	889.3	...	84	61	79.8	64.8	72.3	...	69.7	66.3	84	64	7.8	8.67	7.51	13	3,700
Bulawayo	867.4	868.3	86	56	77.0	61.3	69.1	70.3	67.2	64.5	87	63	8.4	7.98	3.99	18	4,393
Chipinga	890.1	...	85	58	77.2	63.1	70.2	...	69.3	66.5	87	65	7.1	11.27	7.40	19	3,685
Enkeldoorn...	855.6	...	85	56	77.5	61.4	69.5	69.7	66.9	63.6	83	62	7.6	9.74	6.15	18	4,788
Fort Victoria	893.4	893.9	90	56	80.2	64.3	72.3	71.5	70.5	66.9	83	65	5.9	6.59	4.75	16	3,571
Gwaai Siding	901.4	...	92	60	82.4	65.6	74.6	...	71.2	67.3	82	65	7.4	8.17	4.02	14	3,278
Gwanda...	904.2	...	92	59	80.0	64.6	72.3	...	71.0	67.3	83	66	7.8	8.91	3.69	17	3,233
Gwelo	860.2	...	84	57	76.9	61.6	69.3	70.9	66.6	63.7	86	62	7.8	6.56	5.33	18	4,629
Hartley...	883.2	...	86	55	80.5	63.3	71.9	72.3	70.0	66.4	83	64	6.6	5.78	7.27	17	3,879
Inyanga...	835.0	...	80	51	74.7	57.6	66.2	...	66.9	62.4	79	60	6.5	10.62	8.67	17	5,503
Marandellas	835.7	...	80	55	74.4	59.8	67.1	...	65.1	61.7	83	59	6.0	6.00	7.19	15	5,453
Miami	876.6	...	83	61	77.4	63.3	70.4	...	67.8	65.6	89	64	9.2	11.69	4.95	22	4,090
Mount Darwin ...	905.3	...	86	61	82.0	65.9	73.9	..	71.4	68.0	84	66	8.1	5.19	6.61	14	3,179
Mount Nuza	800.3	...	71	48	65.5	54.2	59.9	...	58.5	57.6	95	57	8.8	14.03	9.64	25	6,668
Mtoko	875.1	...	84	60	78.6	64.0	71.4	...	69.5	66.0	83	64	6.6	6.93	5.62	16	4,141
New Year's Gift...	...	...	92	60	82.9	65.5	74.2	...	72.6	68.7	82	67	...	7.87	5.03	17	2,690
Nuanetsi	958.9	...	98	62	87.9	69.4	78.7	...	76.6	72.0	80	70	7.8	10.18	3.04	9	1,581
Plumtree	862.2	...	88	55	76.5	61.2	68.9	...	68.3	63.9	80	62	6.1	8.29	4.43	19	4,549
Que Que	879.5	...	87	57	81.0	63.4	72.2	...	69.3	65.8	84	64	7.7	7.07	6.72	15	3,999
Rusape	860.1	...	84	54	77.9	61.7	69.9	...	67.1	63.7	83	62	7.6	7.00	5 28	14	4,648
Salisbury	854.3	855.1	83	55	78.0	61.0	69.5	69.4	66.8	63.3	83	61	8.5	8.13	6.54	18	4,831
Shabani...	907.8	...	91	60	80.6	66.5	73.6	...	71.5	67.8	83	66	8.3	8.22	4.00	17	3,131
Sinoia	886.1	...	86	61	80.5	64.4	72.5	...	70.0	66.7	85	65	7.5	8.51	6.82	22	3,795
Sipolilo	883.0	...	82	59	78.3	63.1	70.8	...	70.0	66.3	81	64	7.8	9.25	6.97	16	3,876
Stapleford	840.1	...	79	50	72.8	58.6	65.7	...	64.4	62.1	88	61	8.3	16.20	16.91	24	5,304
Umtali...	890.5	891.5	89	58	81.4	63.9	72.7	71.5	70.1	66.9	85	65	8.3	4.41	6.08	18	3,672
Victoria Falls... ...	909.2	...	94	63	84.6	66.0	75.7	...	71.5	68.3	86	67	7.2	15.16	6.09	19	3,009
Wankie	924.1	...	97	67	86.8	69.4	78.1	...	74.4	70.4	83	68	8.0	13.91	4.73	17	2,567

Rainfall in February, 1937, in Hundredths of an Inch. Telegraphic Reports.

Area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Total	Normal
1	53	7	1	53	27	42	19	34	37	32	57	107	32	16	4	5	11	39	35	36	1	...	...	...	...	...	3	1	652	378
2	75	17	...	...	...	20	14	112	29	77	22	25	17	145	55	2	...	12	24	151	28	2	...	...	8	...	13	37	885	540
3	116	3	...	...	1	1	49	55	23	8	50	30	69	101	60	16	...	1	102	123	41	1	1	...	20	...	21	63	955	794
4	67	25	8	10	2	18	23	173	19	39	10	144	59	73	16	42	17	20	15	61	14	1	...	...	...	...	1	12	869	615
5	72	46	8	2	27	15	23	49	36	78	117	243	31	66	23	110	34	126	31	3	71	19	5	8	...	2	...	...	1245	508
6	29	12	2	1	...	84	33	16	77	...	25	21	19	5	93	67	59	18	1	87	31	...	...	5	...	...	..	...	685	707
7	65	5	4	6	16	24	53	11	10	107	27	76	40	44	27	3	8	5	30	63	5	10	2	3	5	...	2	5	656	656
8	132	33	5	3	8	67	50	2	75	2	12	67	48	52	133	10	36	..	13	98	92	13	97	14	...	15	1	4	1082	705
9	28	30	21	...	1	89	143	30	31	4	23	30	60	1	134	13	74	3	8	110	49	24	63	39	6	...	8	...	1022	648
10	129	21	4	...	...	5	63	16	3	43	16	28	26	23	151	...	5	3	14	9	...	...	32	...	...	2	...	13	606	611
Mean	62	21	6	11	12	40	44	51	35	47	44	93	35	48	56	34	28	35	22	67	31	8	14	7	3	1	4	8	867	568

SOUTHERN RHODESIA.

Locust Invasion, 1932-37.

Monthly Report No. 51, February, 1937.

Only one report of locusts in any stage of development was received during February. This report referred to a small outbreak of hoppers near the Kariba Gorge in the Zambesi Valley on the 27th.

So far no hoppers have appeared as the result of the presence of flying swarms in the occupied parts of the northern districts of the Colony during the latter part of January.

It is possible that the disappearance of winged swarms has been largely due to the activity of the locust eating birds, as flying swarms were in evidence up to the beginning of March last year. Disease has not been recorded and parasites have been relatively scarce.

The prospects, at least for the present season, are now definitely favourable.

RUPERT W. JACK,
Chief Entomologist.

Southern Rhodesia Veterinary Report.

JANUARY, 1937.

FOOT AND MOUTH DISEASE.

Disease was diagnosed during the month in the Mtilikwe Reserve, the Victoria Reserve (Shumba dip tank) and the adjoining Mshawasha Native Purchase Area in the Victoria Veterinary District.

TUBERCULIN TEST.

Eight cows were tested upon importation with negative results. The Ireniedale herd, Glendale, comprising fifty head, and ten cows on Devonshire Farm, Umtali, were tested during the month. Three animals in the former herd reacted to the test and one animal on Devonshire Farm gave a suspicious reaction.

IMPORTATIONS.

From the Union of South Africa.—Cows 8, sheep 215.

EXPORTATIONS.

To the Union of South Africa.—Oxen 94, cows 2.

EXPORTATIONS—MISCELLANEOUS.

To the United Kingdom in Cold Storage.—Chilled beef quarters, 5,731; frozen boned beef quarters, 1,389; frozen beef quarters, 4,303; kidneys, 3,061 lbs.; tongues, 11,413 lbs.; livers, 23,994 lbs.; hearts, 8,935 lbs.; tails, 3,762 lbs.; skirts, 3,911 lbs.; shanks, 4,782 lbs.

Meat Products.—From Liebig's Factory: Corned beef, 32,100 lbs.; bone meal, 310,000 lbs.; meat meal, 1,000 lbs.

G. C. Hooper Sharpe,
Chief Veterinary Surgeon.

Farming Calendar.

THE SEASONS IN SOUTHERN RHODESIA.

For all practical purposes the year may be divided into three seasons, viz., the cold season, the hot season and the rainy season.

The Cold Season.—This season commences sometime in May and extends into August. During this period three types of weather occur:—

1. Settled fine weather is the general rule. The days are sunny with a cool easterly breeze, the nights clear and calm, frosts occurring, particularly in valleys, vleis and sheltered places on gently sloping ground.
2. Spells of warmer weather, usually limited to a couple of days. Night temperatures are appreciably higher, and the days warm. Such a spell is almost invariably followed by a cold snap.
3. Cold snaps of varying severity and duration may be expected two or three times in a month. "Guti" weather affects large areas in the south and east of the country. Strong cold winds from S.E. combined with overcast skies, and in hilly parts intermittent drizzle, render conditions unpleasant for man and beast. The normal duration of a cold snap is two or three days, after which settled conditions are re-established. Longer cold snaps (7 to 10 days) have been experienced during recent years, but these are abnormal.

Apart from drizzle during "guti" weather, rain is rare but not unknown during these months.

The coldest time of the year is normally at the end of June or at the beginning of July, but some of the coldest days on record have been in the early part of August.

The Hot Season.—From about the middle of August there is a steady increase in temperature. Short cold snaps may occur up to the end of September, but the subsequent warming up is rapid. The hottest time of the year for most of the country is about the end of October, but in the driest districts temperature increases slightly during November and December.

During October cloudiness increases, and thunderstorms are to be expected, except in the north and west. The storms increase in number and intensity until the regular rains set in. These storms stimulate the growth of grass, but are rarely sufficient to enable crops to be planted, and the hot days in between detract from their value. Some years storms are very few in number. At this time of year evaporation is very high. Gusty winds, mainly from E. or N.E., are prevalent during the mornings, raising the dust and rendering conditions unpleasant.

The Rainy Season.—The first set-in rains usually occur during the last ten days of November, but may on occasions be as much as a fortnight early or late. The December rains are mostly of the thunderstorm type, often heavy, falling during the afternoon or night. There is a tendency for a spell of fair weather to occur after Christmas. The January and February rains are of a more general character, and occur at any time of the day. March rains are mainly in the form of afternoon thunderstorms, and normally there is a decrease in the amount of rain as the month progresses. April rainfall is of little account, except in very wet seasons, when a fair amount may be recorded. "Guti" weather occurs in the south and east at intervals during the rainy season, and is particularly prevalent during March and April. Fair weather usually follows "guti" weather.

HAIL is not of frequent occurrence.

LIGHTNING is often severe, and is responsible for stock losses.

DROUGHT PERIODS (10 days or more when less than 0.10 inches of rain falls on any day) may occur at any time during the season, more particularly in the south.

TEMPERATURE.—There is a marked fall in temperature when the rainy season begins, but the fluctuations during the whole rainy season are not marked unless long dry spells occur.

WIND is usually light, although heavy squalls occur with thunderstorms, sometimes causing damage to plants, trees and farm buildings.

SUNSHINE.—During set-in rains there is very little sunshine, but sunny mornings are associated with thundery weather. On the average fifty per cent. of possible sunshine is recorded during the wet months.

Further details regarding weather or climate in different parts of the country may be had on application to the Meteorological Office, Department of Agriculture.

FORESTRY.

JANUARY.

If the rains are seasonable, plant out evergreen trees, such as gums, cypress, pines, etc. Fill in all blanks as soon as they are noticed, and do not leave them until the following season. Planting should be done on a wet day or, failing that, on a dull day, or late in the afternoon. Great care should be taken to see that the trees are not planted out any deeper than they stood in the tins or beds.

FEBRUARY.

Tree planting operations should be carried out on dull showery days or late in the afternoon. Take care in setting out the plants, avoid bending the roots, and do not plant deeper than the plants were in the seed beds or trays.

MARCH.

Cultivation where necessary should be undertaken between the rows of trees planted out in previous months. If cultivation is carried out with the hoe, care should be taken not to pile earth round the base of the stems. New ground for next season's planting should be roughly broken up with the plough. Bulk plantings may be proceeded with during the month.

APRIL.

Cultivate the soil in the young plantations either by means of machines or hand labour. The cultivation will conserve moisture. Hoed out weed growth should be applied as a mulch round the base of each young tree. Be careful not to pile earth round the stems of the young trees. Covering the stems with earth even for an inch or two interferes with the sap circulation and invites attacks by termites.

Steps should be taken to prepare seed beds for the slower growing species, i.e., pines, cypresses and callitris, and seed of these species may be sown from now until the end of June for planting during the coming rainy season.

MAY.

Start pricking out seedlings into tins. Deciduous trees which are propagated by means of cuttings should be taken in hand. See that the fire lines are in order, and in the case of woods which have formed canopy, remove inflammable material below the edge trees.

JUNE.

Care should be taken by further ploughing of land or burning of grass that all fireguards round plantations are in good order and effective. Thinnings may be carried out where necessary. Cuttings may be taken and struck now of deciduous trees, such as the Carolina poplar. The pricking out of conifer seedlings into tins should be continued, and sowing of such seed for the coming planting season may be completed. A commencement may be made of preparation of land to be planted during the ensuing season, e.g., by stumping if necessary, and ploughing where practicable.

CROPS.

JANUARY.

Turn your compost heaps on a wet day. Plough under witchweed traps within two months from germination. If only one trap is being planted, plant this month. If not already sown, put in the ensilage and fodder crops at once, such as maize and legumes, Kherson and S.E.S. oats and other hay grass crops. Sow short season crops like haricot beans, linseed, buckwheat, peas, summer oats, gram and mung bean, and sunnhemp for hay. Plant out grasses and kudzu vine for pasture. Ridge potatoes and cultivate thoroughly. Main crop can still be planted. Quick growing green manuring crops, such as cowpeas, soya beans and sunnhemp, may still be sown this month. Earth up ground nuts so that a small amount of loose soil is thrown over the crowns of the plants. Cultivate all growing crops well, and thoroughly eradicate weeds. Overhaul all hay-making implements and ploughs and get in thorough repair in preparation for the haying and ploughing seasons. Endeavour to mow grass fields early for hay and litter, and to obtain second cutting for hay in April. Mow grass paddocks infested with annual weeds to prevent the weeds seeding. Prevent Mexican marigold and other noxious weeds seeding by hoeing or pulling out the plants by hand. Keep a sharp look-out for maize stalk borer. Cut off the tops of infested plants or treat them with a recognised chemical preparation. Watch the maize lands for witchweed. Prevent witchweed plants from seeding by cultivation and by hand-pulling the plants. Make as much manure as possible by placing sunnhemp, grass, and litter in cattle kraals, pig sties and stables. If there is stumping and clearing to be done, push on with it.

FEBRUARY.

Turn your compost heaps on a wet day. Cultivate, and keep on cultivating as weather permits, to destroy weeds. Continue to look out for stalk borer, and, if infection is discovered, deal with infested plants as advised in January notes. Watch witchweed and continue cultivating and hand-pulling it. Plough under witchweed trap crops within two months from germination. Where practised, maize can be under-planted with sweet potato vines after the last cultivation for the following season's requirements. Potatoes and ground nuts will probably need to be ridged again. Catch crops of quick maturing beans, such as tepary bean, also buckwheat, can still be sown. Keep down all noxious weeds. This work can be undertaken on wet days. Make veld grass hay whenever a few days of fine weather permit. Early mowings provide the best hay. Keep potatoes in a cool shed, well ventilated. Pick over any potatoes in storage and remove bad ones. Continue to make as much farm manure as possible.

MARCH.

Plough under witchweed traps in time. Watch oats for rust, and, if badly infested, cut crop for hay as soon as weather permits. Ridge late potatoes, and if weather is dry prevent ridges from cracking, to check tuber moth infestation. Finish ploughing under all green manure crops while the ground is still moist enough to promote rapid decomposition. Cut silage crops and ensile. Cut out barren maize plants and feed to stock or ensile. Cut Sudan grass for hay to permit of final late growth for autumn grazing. Reap any crops that are ready, and plough the stubbles at once. Watch for ground nuts making second growth; reap, and when sufficiently dry, place in cocks with nuts inwards and cover the top securely. Watch the weather for hay-making and take advantage of fine spells. Towards the end of the month hay-making should normally be in full swing. Continue to plough all lands in succession immediately the crops are reaped for them. Vleis and irrigable lands should now be ready, or in process of being prepared, for winter crops. Early sowings of winter oats, barley or rye for green forage can be made. Allow any potatoes lifted to dry before storing them, but do not leave too long in the sun. Destroy witchweed and other noxious weeds. Continue to make all the kraal manure possible by throwing grass and litter into kraals, yards, etc. Begin to select in the field maize plants for seed purposes, and mark them with slips of coloured cloth. Press on with the breaking up of any virgin land which may have been stumped or cleared earlier in the year. Place orders for grain bags without delay. Early in the month silage pits should be cleaned out or, where necessary, new pits dug.

APRIL.

Don't forget witchweed cultivation. If sufficiently mature, begin cutting and stooking early maize over a small acreage and plough up the ground whilst still damp between the rows of stooks. Early stooks must be small. Ride your manure and compost to the lands for spreading and ploughing under. If ripe, reap and husk early planted maize, and keep in a separate dump. Continue to make field selections of the best maize plants, and mark those required for seed with strips of coloured cloth. Lift any ground nuts and potatoes showing signs of making second growth. Make silage; cut maize for this when the ears are in the "dough" stage. Feed sweet potato vines to stock, reserving any new growth of vines for grazing in May. Plough in any green manure crops not already turned under. Plough fallowed land. Keep potatoes reserved for seed on racks in a cool place protected from frost, but well ventilated, and green them in subdued light. Pick over potatoes which may be lifted, and remove the bad and diseased ones. Winter cereal crops for grain can be sown towards the end of the month. Remember that good and deep ploughing to a depth of at least 7 to 8 inches is essential, and the basis of all successful arable farming. If the lands are not already ploughed so deep, increase the depth of ploughing about an inch a year until this depth, or even more, is reached. On lands which have been ploughed for a number of years at the same depth, use a grubber to stir up the sub-soil without lifting it to the surface. Too much attention cannot be paid to good tillage. It is usually good practice to follow the plough immediately with a harrow or other suitable implement to break down the clods before they bake hard. Continue breaking up new lands; the earlier this is done the more complete is the decomposition of the vegetable matter in the soil. When making hay or coarse legumes such as velvet and dolichos beans and cowpeas, be sure that the vines are dry before stacking. Handle the hay as little as possible to avoid loss of leaf. Lay in supplies of thatching grass for thatching and repairing roofs. The veld may be beginning to dry off. Consideration may be given to mowing or otherwise preparing fire lines as a preventive against veld fires.

MAY.

Witchweed may still require attention on the stooked lands. Continue to cut and stook maize as it matures; make the stooks small to assist drying and prevent increase of diplodia. Later in the season the stooks may be made larger. See that the stooks are secure and pick up plants lying on the ground. Continue to plough up land between stooks of maize. Give all maize harvested, whether husked or in the husk, a chance to dry out before riding to the dumps. Do not begin shelling if the ears are still damp. Do not use new grain bags for harvesting maize. Make the dumps of unhusked ears as small as possible; the smaller the dump the quicker the grain will dry out. Grain on the cobs dries extremely slowly, if at all, in dumps of large size. Do not mix unhusked ears from the stooks with dryer ears harvested later from the standing crop. Keep the dryer ears in a separate dump; shell, bag and stack such maize separately. When cutting maize for stooking, insist on the stalks being cut at ground level. The plough, in Rhodesia, will not bury roots with stalks 8 to 12 inches high. A long stubble of stalks makes clearing of the ground for ploughing very tedious and expensive. If not already harvested, ground nuts should be lifted before the first frosts damage the hay. Sow most winter cereals on wet vleis or under irrigation early this month. Feed your sweet potato vines to stock; if frosts occur the vines will be killed. Dig and feed tubers from end of month onwards. Towards end of month harvest cattle pumpkins and melons and handle carefully; avoid bruising to prevent rotting. Place pumpkins and melons in a dry situation in the open and in a single layer. Supply plenty of roughage to cattle pens, kraals and stables to increase the manure supply. Collect and cart manure to lands for spreading. Do not attempt to plough in dry grass or quantities of maize refuse. The plough will not turn it under and it will not rot before next planting season. Burn such refuse and make a good job of the ploughing. If the weather seems set fair, commence brickmaking. A small kiln of bricks always on hand is most useful. As labour permits, re-thatch buildings and outhouses in need of repair. Overhaul, grease and paint planters, drills and other implements not required again until next season, and store away under cover. Think about your fertiliser requirements for next season and place your orders. From now onwards the second ploughing of new land broken up earlier in the season should be pushed on with as opportunity offers.

JUNE.

Select seed from the very best of your own crops. It is always wise to keep more seed than you may need for planting. Do not shell and ride your maize to the railway unless it is fit for export or market. Provide ample dunnage for your maize stacked at the railway or on the farm. Use maize cobs; husks are almost useless for this purpose. Select pumpkin and melon seed from the best specimens. Support your agricultural show and make it a success by preparing and entering as many exhibits as you can. No one is more to blame for a poor show than the farmers themselves. Make a list of the seed requirements for next season, and where purchases must be made, place the orders early. Veld fires must be anticipated, and if not already attended to, the mowing or burning of fireguards, both boundary and internal, should be proceeded with.

STOCK.

JANUARY.

Cattle.—Put the bulls into the herd now to secure spring calves. The bulls should be in good condition at the commencement of the service season and their condition should be maintained while they are working. This season calves should be looking well by this time and care must be taken

not to over-milk the cows in consequence. Cows rearing calves should not be milked more than once a day. Bullocks which are being fattened on grass should receive a concentrate ration from now onwards; 4-5 lbs. maize meal daily should be sufficient.

During the months of December and January veld grazing is usually plentiful, and very little extra feed in the form of concentrates is required for dairy stock. It should be borne in mind, however, that heavy milking cows are unable to satisfy their requirements for milk production from veld grazing alone, and should receive a daily allowance of grain; the latter should be fed at the rate of 2 lbs. for every gallon of milk produced daily, *i.e.*, a cow producing three gallons of milk should receive 6 to 7 lbs. of concentrates. An excellent mixture for this purpose is one consisting of four parts maize meal and one part ground-nut cake.

During wet weather, the provision of a clean dry shelter for calves is essential; the latter should not be crowded together in a small, damp, badly ventilated pen or muddy kraal. When treated in this manner, a calf is very liable to contract various ailments such as scour, etc. Scour is entirely preventable, and is usually caused by over-feeding, or feeding from dirty pails, feed boxes, etc. Calves which contract scour should be isolated, the milk ration reduced, and they should be dosed with a few tablespoonfuls of castor oil.

Sheep.—Keep the sheep away from vleis. During this time of the year they are liable to suffer severely from internal parasites and dosing should be regular. If nodular worm is present dose twice at 30-day intervals with the new remedy.

FEBRUARY.

Cattle.—The recommendations for January apply equally to this month. Be careful that the condition of the bulls is maintained, especially in the case of well-bred animals. A bull in poor condition cannot be expected to sire a large number of calves. As far as practicable cut veld hay during this month. Usually the optimum relation of yield and composition occurs now. During this month, in addition to maize, some protein concentrate such as peanut cake or cotton-cake will generally be necessary in the dairy cow mixture to keep up a good milk flow. Increase the grain ration to bullocks which are being fattened on grass and add some protein concentrate to their feed to make good the deficiency of this nutrient in the grazing.

Calves may be given a few hours' exercise on bright, sunny days; young stock, however, should not be allowed to run and graze with the herd, and are best kept in a cool, airy pen opening on to a small shady paddock where they can obtain a little exercise.

A good quality of sweet hay and water should always be available for young calves.

Sheep.—Continue as recommended for January. Dose regularly at 21-day intervals for wireworm and bankrot worm with the nicotine and bluestone remedy. Start putting in green food for April and May.

MARCH.

Cattle.—Arrangements for winter feed should be pushed on. For a well balanced winter ration, in addition to good quality veld hay, a succulent feed such as maize silage, majordas or pumpkins and a legume hay such as velvet beans, cowpeas or dolichos beans are essential. The milk supply will begin to decrease. In the case of cows rearing calves it is often good policy in this month to cease milking cows and to allow the calves to get all the milk from now on. Slightly increase the amount of grain to the dairy cows and increase the proportion of protein concentrate in the dairy cow mixture to make good the usual loss of feeding value in the grass. Bullocks fattening on grass will do better for a daily ration of some succulent feed such as green mealies or sweet potato tops, unless a supply of green grass is still available.

Calves which are under two months old should be kept in and allowed to nibble at well-got hay; at the same time a little dry mealie meal and monkey nut cake will do them good and teach them to eat concentrates. An ample supply of clean water should be provided in the calf run.

Sheep.—Ewes should now commence lambing. Run the big udder ewes with lambs separate. If the grass has gone off the ewes and lambs should have access to some green feed for an hour or two daily. Continue dosing as for February. If hookworm is present dose now and keep ewes and lambs especially away from vleis.

APRIL.

Cattle.—Where winter conditions are good, early spring calves may be weaned now, but a common practice is to allow them to run with their dams until the early rains. Where supplementary feed is available, April to June are probably the best months of the year for cows to calve in. These months also suit the dairy farmer. Dry off cows which will not pay for a grain ration during the winter. Bullocks for winter fattening should be penned from now on. Steers fat off the grass in April are easily and cheaply topped off.

The season of abundant green pasture is over, and the natural grazing, unless supplemented by some green food or succulent roughage, is not sufficient to maintain a full flow of milk. The most economical supplement to veld grazing at this time is maize silage or green maize, and this should be fed in liberal quantities to all milking cows and growing stock. A few pounds of concentrates in addition would also be of great benefit to the milking cows, which should not be compelled to subsist entirely on veld hay and silage.

Sheep.—See that ewes and lambs have sufficient feed and continue dosing for wireworms and bankrot worm.

MAY.

Cattle.—By the middle of this month dairy cattle will require more serious attention in the matter of feed. Grass should be cut for bedding, and both cows and calves, if the weather is too cold, should be well bedded down at night from now onwards, and cowsheds should be put in good repair. Attention should be given to the water supplies, and care taken that they are clean and sufficient.

Boggy sources of water supply are a frequent source of loss of cattle during the winter months. With adequate water supplies cattle can withstand considerable shortage of grazing. Weaners should be fed a good roughage ration—with or without a small allowance of grain, depending on circumstances—to keep them growing through the winter months.

Get in the bullocks for winter fattening.

Sheep.—Especially from now on the ewes and lambs should have adequate feed such as green oats and barley or bean hay and a little maize. This will ensure an adequate supply of milk and hence good thrifty lambs. Dose for nodular worm.

JUNE.

Cattle.—Cows with autumn calves should be kept in the more sheltered paddocks. A watchful eye should be kept on all watering places in order to prevent their being fouled or stopped up. Where winter calves are required, the bulls should be kept out of the herd until the end of July at least, and, in the meantime, they should be well fed and cared for in order to fit them for their work. The three watchwords in the dairy herd should be feed, shelter and bedding from now onwards.

At this period of the year winter feeding of dairy stock should commence in real earnest. The milking cows should now be in fairly good condition, and in order to maintain a full flow of milk throughout the cold, dry months of winter, it is essential that liberal feeding be practised. As

far as possible an attempt should be made to imitate summer conditions by feeding an abundance of succulent and palatable food. Maize silage, sweet potatoes, pumpkins, etc., are very useful for this purpose, but these feeds should be supplemented by dry roughage of good quality, preferably a legume hay, and a liberal allowance of mixed concentrates.

For dairy heifers, weaned calves, etc., there is possibly no better ration than one consisting of maize silage, legume hay and a small portion of mixed concentrates, and these feeds, if supplied in liberal quantities, should serve to keep the young stock in a thrifty, growing condition.

Sheep.—Continue to feed the ewes and lambs well. It is of considerable assistance against parasites. Dose again at three weekly intervals for wire-worm and bankrot worm.

DAIRYING.

JANUARY.

Under the weather conditions which now obtain, cream should be despatched to the creamery at least three times a week. It is of the greatest importance that cream should be cooled immediately after separation, and should be kept cool while on the farm and whilst in transit to the railway station or siding. While the cream is being cooled, it should be frequently stirred, using a stirrer with a plunger attachment. Warm, freshly separated cream should not be mixed with old cream which has already been cooled. Cool the fresh cream first and then mix thoroughly with the old cream. Gassiness is a common defect in the cream received at the creameries at this time of the year, and is caused by gas-producing organisms with which the milk and cream are contaminated. These organisms abound in mud, manure, stagnant water, etc., and develop and multiply very rapidly at high temperatures. Any precautions therefore which may be taken to eliminate dirt, manure, etc., from the milk and to keep the cream cool will prevent the development of gassiness.

As the night temperatures are fairly high, cheese-makers should not attempt to use night's milk for cheese-making; morning's milk plus a starter will give the best results. Gouda cheese-making operations are not usually successful at this season of the year, owing to the poor quality of the milk and the prevalence of gassiness. This type of cheese is best manufactured during March and subsequent months.

FEBRUARY.

This is normally the flush season as far as dairy produce is concerned; dairy cattle are usually in good condition and cows of average capacity should be able to subsist and maintain a full flow of milk on veld grazing alone.

The cheese in the storeroom is apt to develop mould during wet weather. If the cheese is well made and pressed and has a smooth rind, this mould is merely superficial and will not penetrate into the body of the cheese. Rubbing the cheese with a cloth moistened with a weak solution of formalin or permanganate of potash usually checks the development of mould. During these months care must be taken not to use over-acid milk for cheese-making, and great care should also be taken of the starter. If this latter shows any signs of gassiness or develops any disagreeable flavour or odour it should be discarded and replaced by a fresh, clean starter. The cheese storeroom must be kept dark and flies excluded.

MARCH.

This is usually the most favourable month of the year for dairy operations. Cooler nights are now in evidence, and there is usually little difficulty in maintaining a low temperature in the dairy and cheese-room. If elementary precautions are taken, all cream should be first grade, and first-class cheese should be made, as a gassy condition of the milk is rare. Dairy cows, unless they are very high producers, can go without extra rations, because the grass is now in seed and grazing is ample. The cheese storeroom is generally full of cheese, and care should be taken to turn the cheese regularly. The windows and doors should be opened at night and closed in the daytime. A little mould on the cheese will not affect its quality, but if the mould is excessive the cheese should be rubbed daily.

APRIL.

At this season of the year the milking kraal is generally far from clean owing to the excessive amount of mud or dust which has accumulated during the latter part of the rainy season, and in consequence farmers invariably have trouble in producing first-grade cream. Every endeavour should be made to erect a small milking shed in which four or five cows or more can be milked at a time, and every effort should be made to keep the cows clean. The udders should be wiped before milking with a clean, damp cloth, and the farmer should see that the natives' hands are washed with soap and clean water before and after each milking.

If butter is made, the cream and washing water should be put out overnight, and if the cream is churned early the following morning, very little difficulty should be experienced in obtaining a good grain and a firm body in the butter.

From this time of the year onwards, cheese making operations are usually most successful. The evening's milk should not be kept in the dairy, but should be placed outside and covered over with butter muslin, cheese cloth or mosquito gauze netting. Care should always be exercised, however, in using evening's milk. Morning's milk plus a starter usually gives the best quality, and if a starter is used, care should be taken that it shows no signs of gasiness or off flavours.

MAY-JUNE.

At this time of the year the farmer should experience very little difficulty in producing cream of first-grade quality. During the winter months the separator should be adjusted so as to deliver cream testing 40 per cent. butter fat.

On exceptionally cold days care should be taken that the milk is not allowed to become too cold before separation—for efficient skimming, the milk should be separated immediately after milking and at a temperature not lower than 90 degrees F.

Farmers engaged in butter-making are usually successful in obtaining a good grain and firm body in butter at this season of the year. During cold weather it is frequently necessary to warm the cream for churning. The most satisfactory method of warming the cream to the proper churning temperature is to place the bucket or receptacle containing the cream in a tub or bath of water at a temperature of about 95 degrees F., stir the cream frequently and replace the water when cold.

Under the cool conditions which obtain from this time of the year onwards, cheese-making operations are usually most successful.

Care should always be exercised, however, in using evening's milk. If the milk is over-acid it should not be used, or a hard, dry cheese will result. Morning's milk plus a starter usually gives the best quality of cheese. The starter should have a clean sour taste and smell. In early winter, milk for cheese-making frequently contains a high percentage of fat, and in order to firm the curd properly in the whey it is usually necessary to raise the scalding temperature a few degrees.

VETERINARY.

JANUARY-MAY.

Tick life will be very active and in consequence tick-borne disease in evidence, especially redwater and gallsickness, and in districts where the bont tick prevails heartwater in cattle and sheep must be expected. Regular dipping to destroy tick life and minimise losses from disease should be conscientiously carried out. Horse sickness may be expected during these months and until the first frosts appear, usually about June. Blue tongue in sheep will be prevalent in uninoculated sheep. The inoculation of sheep against this disease should not be undertaken in the wet season unless animals can be kept under cover for 21 days following inoculation, and on account of possible abortion resulting, ewes in lamb should not be inoculated. Screw worm may be prevalent.

JUNE-SEPTEMBER.

After the first frost danger of horse sickness should disappear and blue tongue in sheep should be very little in evidence, sheep should be inoculated against this disease. Although cases of redwater and gallsickness occur all the year round, these diseases should not be prevalent. Scab in sheep and goats is a winter poverty disease and may be in evidence. Vegetable poisoning may be in evidence towards the end of August, especially on burnt veldt and with the first appearance of young green shoots.

OCTOBER-DECEMBER.

The first rains may be expected during this period and due to heat and moisture tick life will become active and cases of redwater and gallsickness and other tick-borne diseases may be expected. Occasional horse-sickness may occur during December. Vegetable poisoning may still be in evidence unless grazing becomes good.

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Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Soil Conservation Bulletin.—The articles on soil conservation which appeared in the February and March issues of this Journal have been reprinted in bulletin form. The propaganda sub-committee of the Soil Conservation Advisory Council is anxious that every farmer, rancher, teacher and other person interested in the subject in the Colony should receive a copy.

Copies have been sent to everyone listed in the Farmers' and Ranchers' Section of the Rhodesia Directory for 1937, but as this list may not be complete any person interested in the subject who has not received a copy should write to the Director of Irrigation, Box 387, Salisbury, and one will be sent free of charge.

Tung Oil Enquiry.—The following note has been received from Captain J. M. Moubray, Chipoli, Shamva:—

"In reply to your enquiry as to how the tung oil trees are doing, the variety you gave me were *A. Fordii.* The trees are fruiting this year. They are planted in a deep red soil, the soil exposed in a cutting some few yards distant is at least six feet deep. The trees are, I think, six or seven years old, and I should say they have not done well, as the tallest of them is only six or seven feet high, and some after all that time are little more than four feet high. The largest have perhaps ten fruits on them."

Iodine in Sheep Licks.—Recent work at Onderstepoort has led observers there to draw the conclusion that the addition of potassium iodide, which is the usual form in which iodine is administered to sheep in licks, is unwarranted, and they go further to state that, under conditions of drought the inclusion of potassium iodide in sheep licks may even produce possible detrimental effects.

It may be mentioned that American work carried out some years ago indicated that feeding large quantities of iodine had a definitely detrimental effect on reproduction in sheep.

The points in connection with iodine feeding which were given consideration in South Africa were feed consumption, weight increase, wool production, reproduction and general health.

The "Handbook for Farmers in South Africa."—The Union of South Africa Department of Agriculture and Forestry informs us that the third and revised English edition of the "Handbook for Farmers in South Africa" is now being printed, but will not be available for distribution for another month or two. The price within the Union is 5s. per copy in hard cover binding with paper side, and 7s. 6d. in full cloth binding. Outside the Union the price is 7s. 6d. and 10s. respectively.

The Afrikaans edition is now obtainable at the prices quoted above, and orders for the English edition will now be accepted by the Government Printer, Koch Street, Pretoria, for supply as soon as they are ready for distribution.

Transpiration of Growing Crops.—In a plant which is actively growing sufficient moisture is necessary to ensure that the plant tissues are actually turgid. If this condition is not maintained the maximum possible growth cannot be attained. When plants which are accustomed to more temperate conditions are grown in this country it is natural that they should show signs of wilting at certain times of the day, and although this indicates a loss of turgidity it is not serious unless it is prolonged. We know that if the soils are sufficiently moist plants invariably recover in the evening and maintain their turgidity during the night. When plants wilt and there is not sufficient moisture in the soil for them to recover rapidly then the crop is actually suffering and complete recovery is never quite possible. The loss of water from the growing plants by transpiration is essential to ensure a proper distribution of food throughout the plant and a proper exchange of air and gases in the plant tissues. Any check to transpiration, *e.g.*, wilting, therefore effects the whole growth and development of the plant. The amount of water actually transpired by growing plants is surprising. A large tree in full leaf transpires about 150 gallons of water on a dry day; a crop of mealies during its growing season about 100,000 gallons per acre of plants; a crop of barley twice that amount and a crop of oats four times that of maize. This means that quite apart from evaporation, a crop of maize kept in good growing condition the whole season transpires the equivalent of almost 5 inches of rainfall.

Dairy Education in the German Reich.—In Germany only persons who have acquired the "Dairy Master's Certificate" have the right to act as technical managers of dairies in which 125 gallons or more of milk or cream are handled per day.

The education of a German dairyman begins with a three years' *apprenticeship,* 6 months of which are spent on an

agricultural farm in order to learn the proper methods of milking and cattle management. In this manner the dairyman is brought into close personal contact with the peasant farmer. This period is followed by a course of training at a recognised educational dairy. The personal qualification of the dairy master is subject to careful examination, and great care is taken that his apprentices receive a proper all-round training. The Regional Peasants' Group supervises the education of the apprentices and at least once a year calls a meeting of all persons responsible for the training of apprentices in order to discuss and, if necessary, to improve, the methods employed in dairy education.

The apprentices have the opportunity of qualifying as dairy journeyman in the following branches of dairying:—

1. Dairy farming in general.
2. Emmenthaler cheese making.
3. Soft cheese making.

All apprentices must pass an examination in the chief branches of dairy farming, including book-keeping and the keeping of the quality records.

After a journeymanship of at least two years a training course lasting three months may be attended at a recognised dairy institute, whereby the qualification as head dairyman or head cheesemaker may be obtained. The training given in these courses is chiefly practical. The final examination includes papers on business management, quality improvement, marketing, business organisation and all other subjects dealt with in the course.

The training courses for a *master's certificate* have now been standardised for the whole Reich. Having worked for four years as a dairy journeyman, and having passed a preliminary examination in theoretical and practical dairying, the candidates may obtain the dairy master's certificate after a further course of six months at a recognised educational dairy institute.

In order to obtain a licence as a *master instructor*, to whom a certain limited number of apprentices may be assigned by a special committee, the applicant has to prove

that he has conducted the management of a well-equipped and, as far as possible, also many-sided dairy establishment to the complete satisfaction of the committee.

The last and highest degree of education to be attained in German dairy farming is the degree of "*expert advisor*," obtainable only after following a further special course of lectures. The expert advisors are the officers responsible for giving advice to the leading dairy organisations concerning all branches of the dairy industry.

Export of Cattle to the Union.—The regulations governing the export of cattle to the Union were published as Government Notice 248 of April 16th, 1937. In this it is laid down that any person desirous of exporting cattle shall make application for a permit on a special form, *i.e.*, Schedule A of the regulations, copies of which may be obtained from the Secretary, Department of Agriculture and Lands, Box 387, Salisbury.

Applications for such a permit shall reach the Secretary not later than four weeks and not earlier than six weeks prior to the first day of the month in which it is desired to export cattle, and any application not complying with this regulation may be disregarded.

On receipt of applications the applicant and the Chief Veterinary Surgeon will be notified of the number of cattle allocated by the Minister to such applicant for export, and of the date on which such cattle are to be exported.

The applicant shall arrange with the District Veterinary Surgeon at the port of exit for the weighing and inspection of the cattle to be exported, and also for the entry of such cattle into a camp for the purpose of quarantine for a period of not less than 21 days.

If such cattle comply with the requirements of these regulations a permit for the export of cattle to the number allocated by the Minister may be issued. The District Veterinary Surgeon shall notify the Secretary of the number of cattle actually exported under such permit.

Application for inspection, weighing and quarantining shall be made to the local District Veterinary Surgeon.

No cattle shall be exported from those areas gazetted under Government Notice No. 133 of 1937, as infected, quarantine and semi-quarantine areas for foot and mouth disease.

Permits will be granted for the export of cattle under the following conditions:—

(*a*) Such cattle have undergone immediately prior to entraining, a period of strict quarantine within fenced areas under the supervision of the Veterinary Department, of not less than twenty-one days and that such cattle are "mouthed" immediately prior to removal for entraining.

(*b*) Such cattle are accompanied by a certificate that such inspections have been carried out and that the animals are free from foot and mouth disease.

(*c*) Such cattle are railed direct in sealed disinfected trucks to the Johannesburg quarantine abattoir without detraining en route.

(*d*) Oxen weigh not less than 1,050 lbs. and cows not less than 790 lbs. at the port of exit.

(*e*) The dressed weight of any beast is estimated by the Inspecting Officer to be not less than 50 per cent. of the live weight.

(*f*) Such cattle are free from ticks.

For the purpose of payment of the levy prescribed by Government Notice No. 713 of 1936, the exporter shall authorise the agent in Johanesburg selling cattle on his behalf to remit, within 14 days of the date of the sale of such cattle, to the Accountant the appropriate amount of the levy as required in terms of the Act and notices prescribed thereunder, together with a certified copy of the Account Sales and such other proof of the price realised as may be required. If the amount of the levy is not received by the Accountant within 14 days of such date of sales, the exporter shall pay on demand by the Accountant the amount of levy due. Failure to pay the levy on such demand will render the exporter liable to prosecution.

The net sale price of cattle exported to the Union for the purpose of section 5 of the Act shall be deemed to be the amount received by the exporter after deducting the following expenses (if incurred) from the gross sale price:—

(*a*) Railage charges as per Tariff Book, including such offloading and feeding and watering charges as may be incurred en route.

(*b*) Charges as under payable in the Union:—

Market dues.
Weighing and veterinary expenses.
Insurance.
Levy payable on cattle slaughtered in the Union.
Auction tax (provincial).
Auctioneer's commission.
Feed for cattle overnight.

Nothing in these regulations contained shall be deemed to exempt any person from complying with the provisions of any law in force relating to the movement of cattle.

STOCK IMPROVEMENT SCHEME.

The conditions under which stockowners may obtain assistance from the funds provided for the importation and improvement of stock are published herewith for general information.

1. The object of the Stock Improvement Scheme is to provide means whereby approved stockowners in the Colony may obtain assistance to improve their herds or flocks.

The general condition and health and the methods of management applied to an applicant's herd or flock, especially in respect of the young stock, will generally be taken as the measure of efficiency of the stockowner for the purposes of this scheme.

2. The present scheme will be operative from 1st April, 1937, to 31st March, 1938, inclusive, and will be limited to the sum of £3,000 provided by Parliament for importation and improvement of stock under the votes of the Department.

3. All applications for assistance during the currency of the present scheme should reach the Secretary, Department of Agriculture and Lands, P.O. Box 387, Salisbury, not later than the 30th June, 1937.

Applications will be dealt with as far as possible in the order in which they are received, and applicants who have not received assistance under the scheme in previous years will be given preference; others will thereafter receive preference in proportion to the measure of assistance previously accorded.

4. Assistance will be limited to such stock-farmers as are, in the opinion of the Department of Agriculture, likely to make beneficial use of a good sire or pure-bred female stock in their herds.

The following conditions are, therefore, required to be complied with on the applicant's farm:—

(*a*) *Cattle.*—Sufficient supplementary feed must be available for the sire and weaners and young stock during the dry season, and sufficient camps must be provided, or other satisfactory arrangements made, to prevent heifers being bred until they reach breeding age.

(*b*) *Sheep.*—The flock must be dosed regularly as may be needed for internal parasites.

The ram must only be run with the ewes during the breeding season.

Sufficient supplementary feed must be available for the lambing season.

(*c*) *Pigs.*—Farrowing pens are required to be provided with concrete floors.

The bull, ram or boar selected must be approved by an officer of the Department of Agriculture and Lands and must be of a type considered suitable for the herd or flock of the applicant and for the conditions obtaining on the farm.

5. *A.—Animals imported direct from the United Kingdom or other territories overseas.*—The Government will contribute to the cost of importing stock from overseas as follows:—

(1) Pedigree Bulls.—A sum not exceeding half the certified landed cost of the bull on the owner's farm in Southern Rhodesia, provided that the total Government contribution in respect of any one animal shall not exceed £75, and provided further, that this contribution shall not exceed the original certified cost of the bull. In arriving at the "landed cost" of the bull, buying expenses, such as travelling expenses and agents' commission, etc., shall not be included.

The export of any animals from the United Kingdom on which a Government contribution is made must be arranged through the office of the High Commissioner for Southern Rhodesia in London.

The importer will be required to:—

(*a*) submit a certificate from the breed society concerned showing that the bull is considered by the society to be good value for the money paid, or, failing such

certificate, the animal will be valued on arrival by an official of the Department of Agriculture and Lands for the purpose of determining the maximum Government contribution payable in respect of the animal;

(*b*) insure the imported animal from date of purchase and for a period of one year after arrival in the Colony for a sufficient sum to cover the expenditure incurred, and to undertake to refund to the Government the contribution made towards the purchase price if the animal should die prior to arrival, or within one year of arrival, in the Colony.

(2) Pedigree Rams and Boars.—A sum not exceeding half the landed cost of the animal on the owner's farm in Southern Rhodesia, provided that the total Government contribution in respect of any one animal shall not exceed £25, and provided further, that this contribution shall not exceed the original certified cost of the animal. In arriving at the landed cost of the animal, "buying expenses," such as travelling expenses and agents' commission, etc., shall not be included.

The export of any animal from the United Kingdom on which a Government contribution is made must be arranged through the office of the High Commissioner for Southern Rhodesia in London.

The importer will be required to submit—

(*a*) a certificate from the breed society concerned that the animal is considered by the breed society to be good value for the money paid; or

(*b*) failing such certificate, the animal will be valued on arrival by an officer of the Department of Agriculture and Lands for the purpose of determining the maximum Government contribution payable in respect of the animal.

B.—Animals purchased in this Colony or imported from any territory in South Africa.—The Government will contribute to the purchase of such animals as follows:—

(1) Bulls.—A sum not exceeding half the certified cost of the bull, provided that the total Government contribution in respect of any one animal shall not exceed £15, except, that

at the discretion of the Minister of Agriculture and Lands, this contribution may be increased to £25 in the case of stud bulls for use in established pedigree herds.

(2) Rams and Boars.—A sum not exceeding half the original certified cost of the ram or boar, provided that the total Government contribution in regard to any one animal shall not exceed £4.

6. Assistance to any one breeder or partnership will be limited to two bulls, two rams or one boar during the year, and under no circumstances will a contribution be made towards the cost of more animals than are deemed necessary by the Department for the requirements of the applicant's own herds or flocks.

Under special circumstances approved by the Minister of Agriculture and Lands, approved breeders may be assisted to effect the purchase of pure-bred female stock.

In such cases the contribution made by the Government shall not exceed half the amounts granted for the respective sires.

The other conditions in regard to the grants for female stock shall be similar to those for the respective sires.

In the event of a shortage of funds, if necessary, the number of bulls may be limited to one per applicant. The applications for grants in respect of male stock shall receive precedence over those for female stock.

7. No animal, except under special circumstances, to be approved by the Minister of Agriculture and Lands, shall be eligible for more than one grant during its lifetime.

8. Breeders who have bulls, rams or boars for sale, which are likely to be suitable for use in this Stock Improvement Scheme, are invited to send full particulars of each animal for sale to the Secretary, Department of Agriculture and Lands, P.O. Box 387, Salisbury, who will cause the animals to be inspected and the information in regard to them to be brought to the attention of applicants requiring such stock.

It is notified that—

(*a*) no grants will be paid on bulls which are seven years of age or older;

(*b*) no animal on which a grant is made may be sold or disposed of within a period of two years from the time when the grant is made, except that previous consent in writing be obtained from the Secretary, Department of Agriculture and Lands. Failing such approval, the seller will be required to refund the amount of the grant to the Department, and the acceptance of a grant by an applicant will be taken to imply agreement to this condition;

(*c*) South African and Southern Rhodesian bred bulls approved for a grant under the scheme will be branded with the letter O. Bulls, rams and boars may also be marked with a numbered ear tag for further identification;

(*d*) animals approved must be of service age and in good service condition;

(*e*) no grants will be made for the purchase of stock from outside this Colony unless it can be shown to the satisfaction of the Minister of Agriculture and Lands that suitable animals at a reasonable price are not obtainable in Southern Rhodesia.

The Feeding of Different Winter Supplements

TO YOUNG GROWING STEERS AND THE EFFECT OF THESE SUPPLEMENTS ON THE SUBSEQUENT DEVELOPMENT AND COSTS OF PRODUCTION OF THE STEERS.

By C. A. Murray and A. E. Romyn.

Summary.—An experiment was carried out to determine: (1) what quantity of cowpea hay would replace 1—1½ lbs. of groundnut cake in a ration for wintering young steers. (2) Whether the addition of a small quantity of maize and maize silage to a basal ration of 1 lb. of groundnut cake would be economic.

Three similar groups of young Hereford steers were carried through two successive winters on the following rations:—

Group I.—1-1½ lbs. groundnut cake per head per day.

Group II.—4-6 lbs. cowpea hay per head per day.

Group III.—1 lb. groundnut cake, 1-3 lbs. maize meal and 2-5 lbs. maize silage per head per day.

There was no significant difference between the three groups when marketed at the end of the summer following the second winter's feeding and it was concluded that under farm conditions the ration of 4-6 lbs. of cowpea hay was probably the best of the three tried.

Description of Experiment.—In an experiment carried out at this Institution by Murray, Romyn and others* it was

Rhod. Agric. Journal, XXXIII., 6, p. 422.

found that the natural pasture, including browse, in the parts of Matabeleland represented by the Matopo sand veld apparently supply a sufficiency of sodium, chlorine and phosphorus for growth, but that there was a serious deficiency of protein in the pasture during the winter months and probably a deficiency of energy as well towards the end of the winter.

It was shown that the feeding 1 to 1½ lbs. of groundnut cake per head per day during the winter months:—

(*a*) Prevented young growing cattle from losing condition during the winter.

(*b*) Improved their conformation, quality and finish from a beef standpoint and considerably reduced the time and feed required to finish them off as chillers for export.

(*c*) Eliminated losses due to poverty and weakness just after the commencement of the rains.

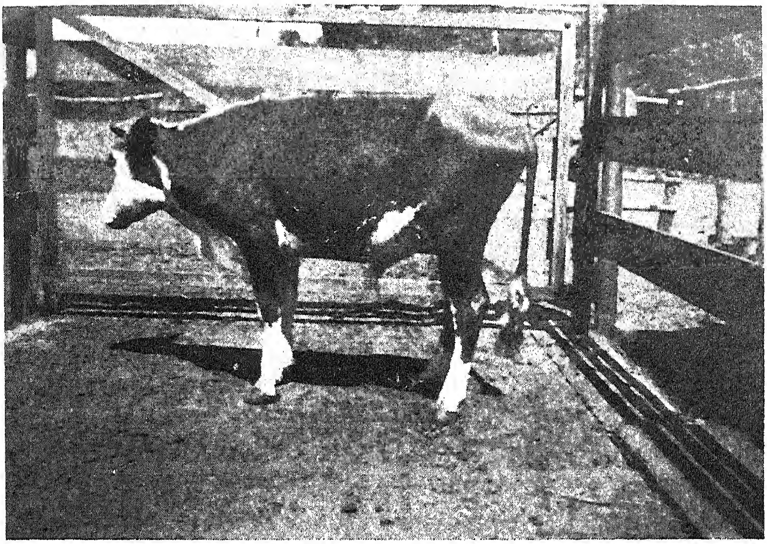
Groundnut cake is, however, a feed which has to be purchased off the farm and as the local supply is limited the present experiment was planned to use farm grown feeds in place of groundnut cake and to determine—

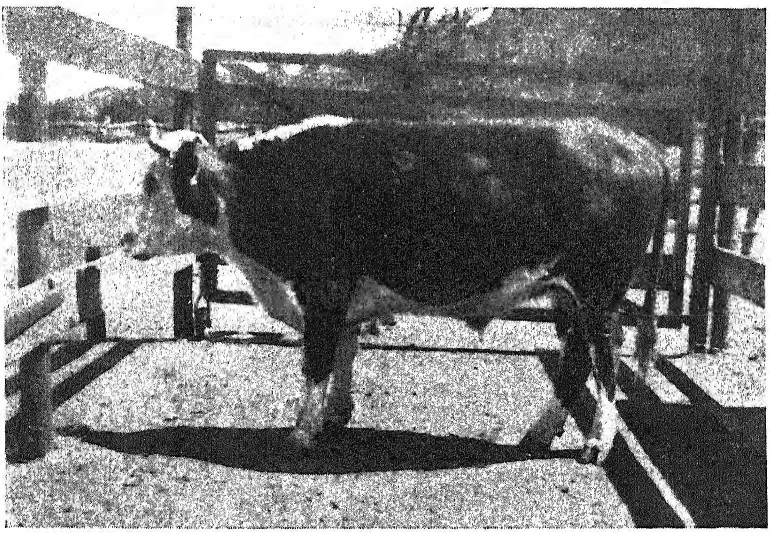
(*a*) What quantity of cowpea hay would replace 1-1½ lbs. of groundnut cake in the winter ration of a growing steer.

(*b*) Whether the addition of a small quantity of maize and maize silage to the groundnut cake so as to bring the young stock through the winter in better condition would be economic.

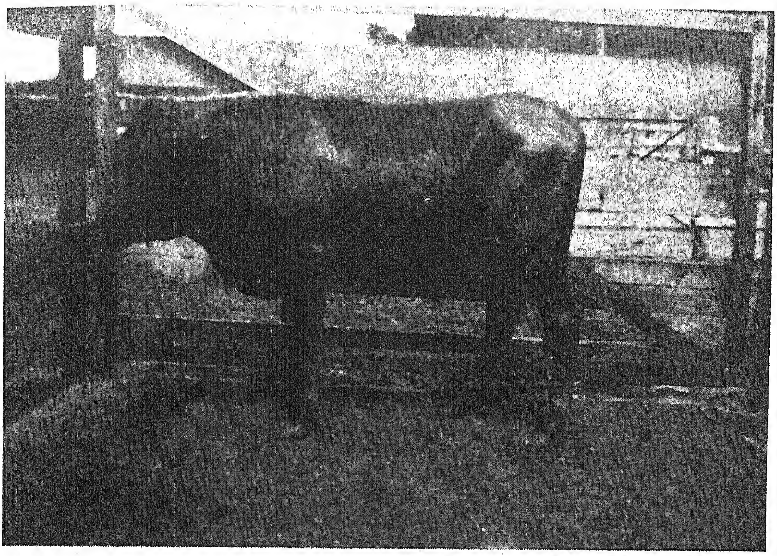
The work was carried out at the Rhodes Matopo School of Agriculture and Experiment Station, Bulawayo, during the period 5th July, 1933, to 9th April, 1935.

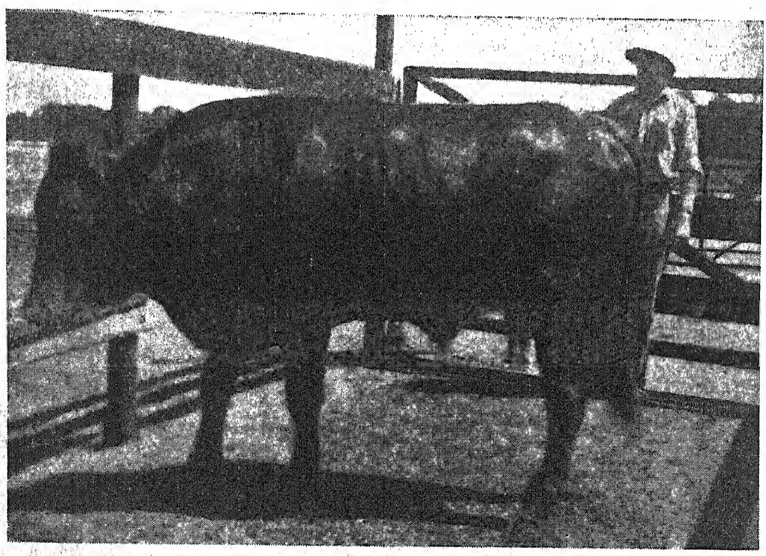
Experimental Animals.—Thirty well bred grade Hereford yearling steers were used in the experiment. They were





Group I. as at 1.12.33 and 9.4.35.





Group III. as at 1.12.33 and 9.4.35.

divided into three groups of 10, similar in respect to age, weight, condition and type.

Rations.—During the winter months the following rations were fed to the three groups:—

Group I.—1 to $1\frac{1}{2}$ lbs. of groundnut cake per steer per day.

Group II.—4 to 6 lbs. of cowpea hay per steer per day.

Group III.—1 lb. groundnut cake, 1 to 3 lbs. of maize meal and 2 to 5 lbs. of maize silage per steer per day.

Management.—The steers were grazed throughout the experiment in a sand veld paddock in which there was ample grazing and good water. During the summer months they were left undisturbed, but at the beginning of winter the feeding of the different supplements was commenced as soon as it was noticed that the cattle were losing condition on the veld grazing only. They were collected every morning for this purpose and taken to the feeding pens, which were in the paddock, and each animal was fed *individually* its supplementary ration.

Records.—The steers were weighed separately at 28-day intervals. The weighings were taken on three successive days and the mean weight taken as the weight for the period.

EXPERIMENTAL RESULTS.

Growth Data.—The average weights of the three groups of steers at approximately 28-day intervals are given in Table I. These data are shown in graphic form in Figure I. and summarised in Table II. In Figure I. particulars are also given of the rainfall during the period of the experiment.

TABLE I.—*Average Live Weight of Steers at 28-day intervals throughout the experiment.*

Date.	GROUP I. 1—1½ lbs. Groundnut Cake.	GROUP II. 4—6 lbs. Cowpea Hay.	GROUP III. 1 lb. Goundnut Cake. 2 lbs. Maize Meal. 5 lbs. Maize Silage.	
	lbs.	lbs.	lbs.	
5/ 7/33	557	559	557	1st Winter.
2/ 8/33	569	572	572	
30/ 8/33	565	557	562	
27/ 9/33	574	560	584	
25/10/33	566	554	592	
22/11/33	573	567	601	
20/12/33	622	597	634	1st Summer.
17/ 1/34	711	692	722	
14/ 2/34	749	729	753	
15/ 3/34	754	743	765	
11/ 4/34	789	774	799	
9/ 5/34	826	814	830	
6/ 6/34	817	806	827	2nd Winter.
4/ 7/34	812	792	826	
1/ 8/34	802	773	829	
29/ 8/34	804	763	848	
27/ 9/34	811	769	837	
24/10/34	820	774	848	
21/11/34	790	736	819	
20/12/34	848	782	862	Final Summer.
16/ 1/35	935	878	936	
13/ 2/35	1,014	953	1,008	
12/ 3/35	1,057	1,000	1,061	
9/ 4/35	1,128	1,060	1,125	

TABLE II.—*Summary and Statistical Analysis of Growth Data.*

			GROUP I.	GROUP II.		GROUP III.	
			1—1½ lbs. Groundnut Cake.	3—6 lbs. Cowpea Hay.		1 lb. Groundnut Cake. 5 lbs. Maize Silage. 2 lbs. Maize Meal.	
Date.	Stage.	Average age of steers.	Average live weight and S.E. of mean.	Average live weight and S.E. of Mean.	Average gain or loss over Group I. and S.E. of difference	Average live weight and S.E. of Mean.	Average gain or loss over Group I. and S.E. of difference
		Months.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
5/ 7/33	Commencement	18	557±19.4	559±18.2	+ 2±26.6	557±15.5	0±24.8
22/11/33	End 1st Winter	22	573±22.3	567±19.2	− 6±29.5	601±18.6	+28±29.0
9/ 5/34	End 1st Summer	28	826±21.2	814±23.1	−12±31.4	830±19.9	+ 4±29.1
21/11/34	End 2nd Winter	34	790±26.3	736±26.9	−54±37.6	819±33.4	+29±42.5
9/ 4/35	End 2nd Summer	39	1,128±24.9	1,060±41.5	−68±48.4	1,125±24.9	− 3±35.2

Feed Consumption.—The daily and total amounts of supplementary feed given to the steers in the three groups during the winter periods are given in Table III.

TABLE III.—*Feed Consumption of different Groups.*

	Period.	Feeding days.	GROUP I. Groundnut Cake. Daily. lbs.	Total. lbs.	GROUP II. Cowpea Hay. Daily. lbs.	Total. lbs.	GROUP III. Groundnut Cake, Maize Meal, Maize Silage. Groundnut Cake. Daily. lbs.	Total. lbs.	Maize Meal. Daily. lbs.	Total. lbs.	Maize Silage. Daily. lbs.	Total. lbs.
First Winter.	5/7/33-18/10/33	91	1.0	91	3.2	288	1	91	1.1	103	2.3	210
	19/10/33-28/11/33	35	1.5	52	6.5	227	1	35	3.0	105	5.0	175
	Total	126	1.1	143	4.1	515	1.0	126	1.7	208	3.0	385
Second Winter.	11/5/34-24/6/34	38	1.0	38	3.0	114	1.0	38	2.0	76	4.0	152
	25/6/34-15/12/34	150	1.5	225	6.4	958	1.0	150	2.4	366	4.4	666
	Total	188	1.4	263	5.7	1072	1.0	188	2.4	442	4.4	818

DISCUSSION.

For the sake of convenience, the data for the different summer and winter periods* of the experiment will be discussed separately.

Period A.—First Winter—5/7/33 to 22/11/33.—From Table I. and Figure 1 it will be seen that throughout this period the Groups I. and II. steers kept practically level and at the end, on the 22nd November, 1933, weighed on the average 573 and 567 lbs. respectively. Group III. differed slightly from them. During the first 56 days of this period (5.7.33 to 30.8.33) this group remained the same in average weight as Groups I. and II., but from the 30th August, 1933, it appeared to do slightly better than the other two. The difference of 28 lbs. and 34 lbs. between Groups I. and III. and II. and III. are, however, too small to be significant (Table II.) to be ascribed to the increased supplements fed to Group III. and may be due to the differences in the individuality of the different lots.

From Table III. it will be seen that during this winter the average daily ration per steer was 1.1 lbs. of groundnut cake for Group I., 4.1 lbs. of cowpea hay for Group II., and 1 lb. of groundnut cake, 1.7 lbs. of maize meal and 3.0 lbs. of silage for Group III.

From the weights of the steers (Table I.) at the end of the period it appears that 4.1 lbs. of cowpea hay was as effective as 1.1 lbs. of groundnut cake and that the addition of 1.7 lbs. of maize meal and 3.0 lbs. of silage to 1 lb. of groundnut cake made very little difference in the weights of the animals to which it was fed in comparison with the other two groups.

Period B.—First Summer—22/11/33 to 9/5/34.—During this period all three groups of steers made very satisfactory gains

*"Summer" denotes the growing season of the pasture and "winter" the dry season. The dates at which these seasons commence is dependent on the annual rains, hence the variable lengths of the "summer" and "winter" periods in the different years.

in live weight. Although Group II. was throughout a little lighter (12 to 25 lbs.) than Group I., the differences are negligible. It is of interest, however, to note that both Groups I. and II. during this summer period very soon caught up with the Group III. steers, and at the end of the summer on the 9th May, 1934, there was no significant difference between the average weights of the three groups of steers.

Period C.—Second Winter—9/5/34 to 21/11/34.—During this period the Group I. steers maintained the weights they had reached at the end of the previous summer until "the scouring period which in this season occurred after the 4th October with the first flush of grass after the rains when they lost on the average 30 lbs. per head. The steers in Group II. did not maintain their weights during the second winter. Gradually as the season went on the difference in weight between Groups I. and II. increased until at the end of the winter Group II. weighed on the average 54 lbs. less than Group I. Although this difference was not statistically significant (Table II.) it did appear that Group II. did not winter quite as well as Group I. The only explanation that could be offered at this stage was that it was observed that the Group II. steers, because of the bulky nature of their ration (cowpea hay) did not graze as freely as the Group I. steers.

Throughout this period Group III. did slightly better than Group I., but at the end it weighed only 29 lbs. heavier. This difference was not significant (Table II.) and therefore cannot be said to be solely due to the extra supplements fed. This small difference in favour of Group III. is less than was expected and can probably be explained by the fact that the steers in Group III. in the same way as Group II. did not graze as well as the Group I. steers.

The steers in Group III. were, however, 83 lbs. heavier than those in Group II. This difference is large enough to be significant, and one can say with some certainty that the ration with the maize silage gave better results than cowpea hay alone.

Period D.—Second Summer—21/11/34 to 9/4/35.—During this period all the steers again did very well, but Group I. made better gains than either Group II. or III. After two months on the summer grazing Group I. had, in the same way as during the previous summer, caught up again to Group III. and eliminated the difference which existed between these two groups at the end of the previous winter.

Though Group II. made better gains than Group III. during the summer and actually reduced the difference of 83 lbs. that existed at the end of the previous winter to one of 65 lbs., it did not do as well as Group I., which was still 68 lbs. ahead of Group II. at the end of the summer.

The difference between all three groups at the end of the summer were all too small, however, to say definitely that any one winter ration had given better results than the other. Though the cowpea hay group did not do quite as well as the other groups, this difference was probably due to the individuality of the steers.

Cost of Winter Supplements.—The amounts of supplementary feed given to the three groups during the two winters and also the approximate costs* of these is given below in Table IV.

From Table IV. it will be seen that during the two winters Group I. consumed 406 lbs. of groundnut cake costing £1 10s. 6d., Group II. 1,587 lbs. of cowpea hay valued at £1 11s. 9d. and Group III. 3.4 lbs. of groundnut cake plus 650 lbs. of maize and 1,203 lbs. silage worth £2 13s. 11d.

As there was practically no difference between the three groups of steers, it is clear that the rations fed to Groups I. and II. were much more economical than those fed to Group III.

*Groundnut cake at £7 10s. 0d. per ton, maize at 7s. 6d. per bag, silage at 10s. per ton and cowpea at £2 per ton. Variations in the prices of these feeds will naturally affect these costs. A farmer can, however, substitute his own costs for those given.

TABLE IV.

	GROUP I. Quantity.	GROUP I. Cost.	GROUP II. Quantity.	GROUP II. Cost.	GROUP III. Quantity.	GROUP III. Cost.
lst Winter ...	143 lbs. cake	£0 10 9	515 lbs. cowpea hay	£0 10 4	126 lbs. cake	£0 9 5
					208 lbs. maize... ...	0 7 10
					385 lbs. silage ...	0 1 11
						£0 19 2
nd Winter	263 lbs. cake	£0 19 9	1,072 lbs. cowpea hay	£1 1 5	188 lbs. cake	£0 14 1
					442 lbs. maize... ...	0 16 7
					818 lbs. silage ...	0 4 1
						£1 14 9
tal...	406 lbs.	£1 10 6	1,587 lbs.	£1 11 9	314 lbs. cake... ...	£2 13 11
					650 lbs. maize ...	
					1,203 lbs. silage ...	

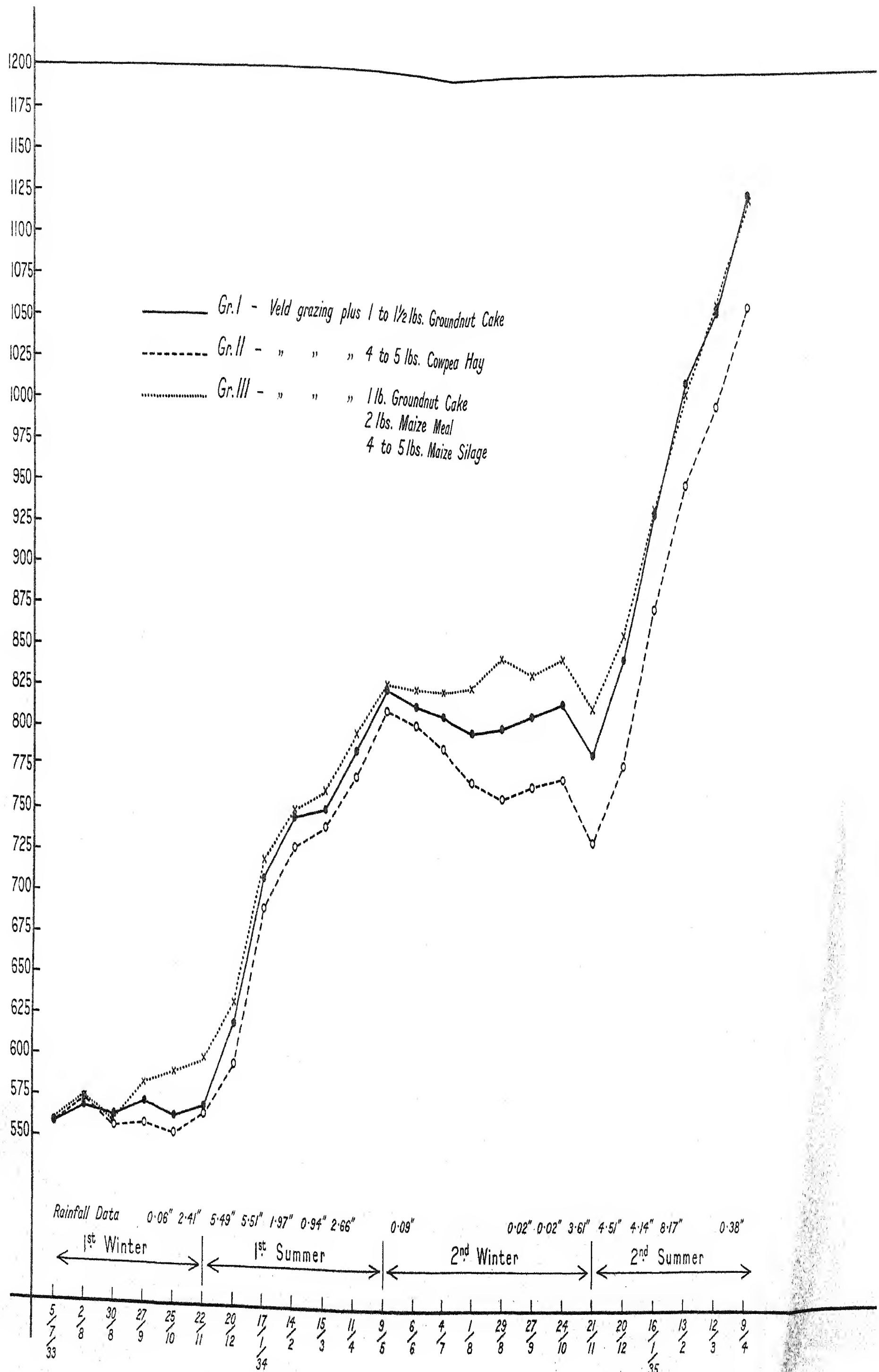
In each case the groups, which came through the winter in lower, but thrifty, condition, made up most of the leeway the following summer.

Group I. was, however, fed on groundnut cake which is a purchased feed, while Group II. received cowpea hay which practically every farmer in the Colony can produce on the farm in abundance and possibly at a figure less than £2 per ton where good yields are obtained. The cowpea is a necessary crop in most crop rotations, and so in addition to its value as a feed it has a high value as a soil renovator. For these reasons it is felt that the cowpea hay was, everything considered, the most economical supplement of the three used.

Conclusions.—In this experiment it appeared that:—

1. 4-6 lbs. of cowpea hay per head per day gave as good results as 1—1½ lbs. of groundnut cake in the winter ration of young steers. The cowpea hay had the added advantage that it is a farm grown feed and fits well into a normal rotation of crops.

2. The addition of 1½ lbs. to 2½ lbs. maize and 3-5 lbs. maize silage to the basal ration of 1 lb. groundnut cake did not prove economic.



1200
1175
1150
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1100
1075
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1000
975
950
925
900
875
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775
750
725
700
675
650
625
600
575
550
Gr. I - Veld grazing plus 1 to 1½ lbs. Groundnut Cake
Gr. II - " " " 4 to 5 lbs. Cowpea Hay
Gr. III - " " " 1 lb. Groundnut Cake
2 lbs. Maize Meal
4 to 5 lbs. Maize Silage
Rainfall Data 0·06" 2·41" 5·49" 5·51" 1·97" 0·94" 2·66" 0·09" 0·02" 0·02" 3·61" 4·51" 4·14" 8·17" 0·38"
1st Winter
1st Summer
2nd Winter
2nd Summer
5/7/33 2/8 30/8 27/9 25/10 22/11 20/12 17/1/34 14/2 15/3 11/4 9/5 6/6 4/7 1/8 29/8 27/9 24/10 21/11 20/12 16/1/35 13/2 12/3 9/4

Notes on Tobacco Root-Knot Nematode.

By J. C. Collins, B.Sc., Biologist, Trelawney Tobacco Research Station.

The root-knot nematode (*Heterodera marioni*, Cornu.) or the tobacco eelworm as it is generally called by farmers, is fast becoming the most serious pest of the tobacco industry in this Colony.

During the last two seasons there have been many reports of serious infestations throughout the country, while certain growers report the presence of eelworm occurring in small patches in all their lands. In circumstances such as the latter, unless precautions are taken to prevent spread it will not be long before it will be impossible for those farmers to produce a clean tobacco crop.

The seriousness of the pest cannot be too greatly emphasised and growers are strongly recommended to enforce measures of control as soon as they detect the presence of nematode in their lands. Small and isolated patches can be controlled more readily and more economically than large areas.

The object of this article is to enable growers to detect the presence of eelworm in their seed beds and lands and to advise them as to what precautions to take when infestation occurs in small isolated areas.

Symptoms.—Infested plants are almost invariably dwarfed, the leaves are paler in colour and sometimes the lower leaves at first, and later the upper, turn yellow and die while the plant is still quite young. The plants often wilt when the sun is hot, even though there be ample moisture in the soil. In seasons when the plant has been able to get away early and has a well-developed root system the above symptoms are not easily apparent and it is difficult to differentiate between diseased and healthy plants.

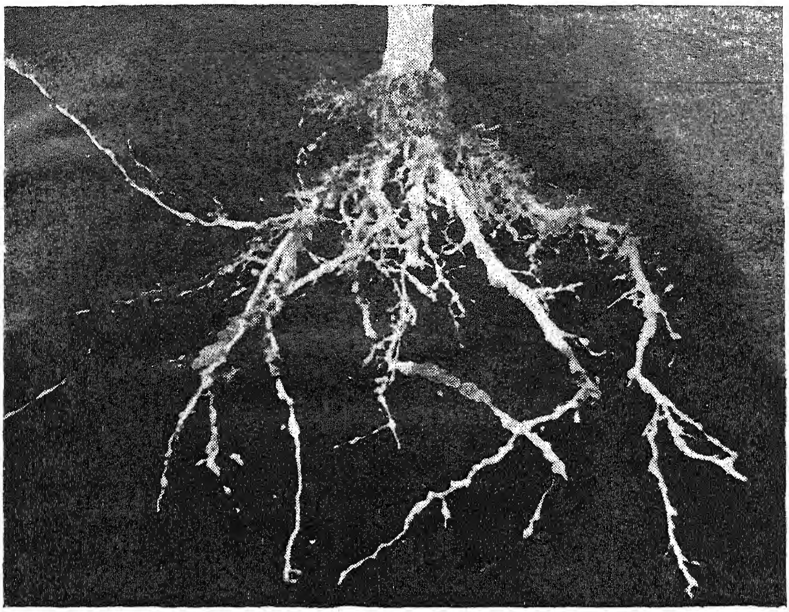

Fig. I.

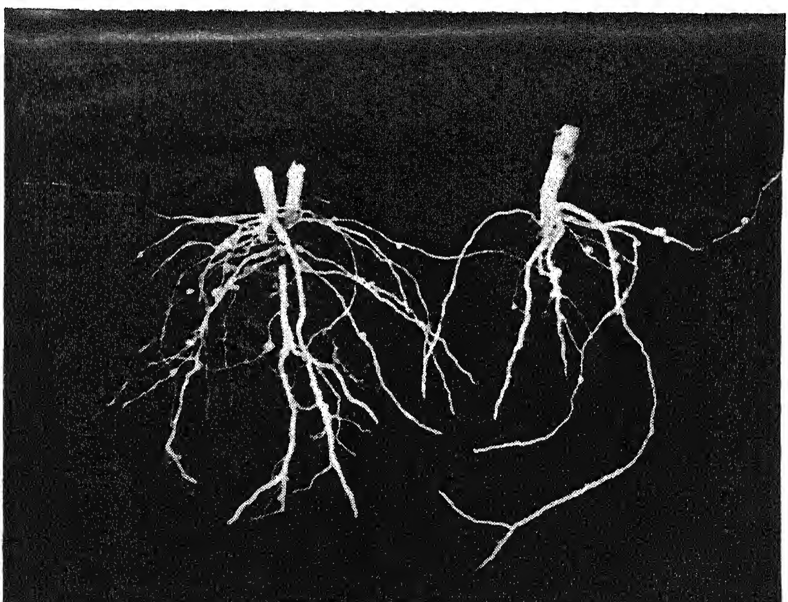

Fig. II.

The characteristic symptom is the presence of swollen or galled roots (see fig. I.).

Where leguminous plants are concerned, care must be taken not to mistake the ordinary bacterial or nitrogenous nodule (see fig. II.) for the gall formed by the activities of the nematode. Generally speaking the nitrogenous nodule is more spherical in shape and is attached to the root by a small neck and can be easily detached, whereas the nematode gall is more elognated, is a swelling of the root itself and cannot be detached. In severe cases of eelworm attack the root develops a decaying and gnarled appearance.

If galls are opened it will be found that the females are glistening, white, semi-transparent pear-shaped bodies visible to the naked eye, being about the size of a pin head. The males are worm-like in shape. Males, larvae and eggs are microscopic in size.

Methods of Dissemination.—The larvae of *H. marioni* are capable of travelling in the soil by their own exertions. The distance travelled in such manner is largely dependent upon the nature of the soil, being greater in sandy soils than in heavy or clay soils. It has been estimated that *H. marioni* can cover a distance of three centimetres per week([1]) (*i.e.*, little more than an inch).

It should be clearly understood, however, that this figure merely refers to the distance the eelworm is able to travel unaided and that infection can be spread very rapidly by the aid of mechanical agencies such as surface drainage, irrigation and by soil adhering to implements and the feet of persons and animals.

Control.—Owing to the value of agricultural land in this Colony being so low, it is not possible for the Rhodesian farmer who has large acreages of land infected with eelworm to avail himself of the expensive chemical treatments used in European countries. In a country such as this the cost of control for large areas would probably be considered prohibitive if more than thirty shillings per acre, but on farms where the infected areas are localised and small this figure might be considerably increased, as it would be well worth the money spent to nip in the bud the chances of spread of infection.

The following is a suggested list of measures of control:—

1. Prevention is better than cure, and bearing in mind that one of the chief methods of dissemination is by surface drainage, the farmer when opening up new land is advised to first bring into cultivation lower lying areas (properly drained) and then to gradually work up the slope. The idea being that should infection appear in the land at the foot of the hill the eelworm will tend to be washed downwards and so leave the more elevated and unstumped areas clean for future use.

2. When selecting virgin land for purposes of cultivation attention should be paid to the cleanliness of the indigenous flora. There are several weeds known to harbour *H. marioni*. The more common of these are referred to in the Host List to be found at the end of this article. Should nematode galls be detected (no matter how slight the infection may be) on the roots of any weeds, that land should most definitely be left alone, for tobacco is one of the most favoured hosts of *H. marioni* and growing it in such infected areas would be courting disaster.

Experiments carried out by the writer have shown that by growing tobacco on land known to be infested the infestation can be increased by ninety per cent. in a single favourable year.

When examining roots for the presence or absence of galls, care should be taken to remove the plants with a hoe or other suitable implement so that the whole root system is available for inspection.

3. Examine the roots of tobacco plants in the seed beds to see that no galls are present. Diseased plants are usually more backward than healthy ones, and on close examination small galls are to be found on the roots.

Remember that there may be an exceedingly large number of eelworm within a single infested root and that the average number of eggs laid by a single female is three hundred to six hundred(2).

4. Should infection be apparent on a farm, a useful procedure would be to permit of dry fallow with vigorous weed eradication for one year (due precautions being taken to prevent spread by surface drainage), followed the next two

years by resistant crops commencing with, preferably, a resistant legume which could be ploughed under. Tobacco or other host crop could be planted, if necessary, in the fourth season.

Care should be taken that any implements used in an infected area be thoroughly cleaned of all soil before being used on clean land. Attention should also be paid to the feet of persons and animals working in such area. The ideal method of cleaning would be the use of a suitable disinfectant such as Kerol used in the proportion of one gallon of Kerol to twenty gallons of water. Natives could be made to wash their feet in it thoroughly and implements could be left soaking in the solution for at least ten minutes. If the ideal cannot be attained every effort must be made to avoid carrying infected soil to clean lands.

Another alternative would be to use the large ploughs only on clean areas and to plough small infected areas with small single-furrow ploughs which are to be bought quite cheaply. These latter are very easy to clean and should be used for no other purpose than ploughing infected areas.

5. Where tobacco crates and "machillas" are made with sacking, care should be taken that the sacks have not at any time held nematode-infected potatoes.

6. Many garden plants (see Host List at end of article) are susceptible to attack. Precautions should be taken to see that garden refuse is not mixed with manure to be used in tobacco lands.

7. Where it is proposed to apply farmyard manure to lands, first see that any weeds growing in the manure are free from nematode galls.

8. Should any infection be found in tobacco seed beds that site should certainly not be used the following year.

9. Where tobacco seed beds are watered from a river or stream there is danger of the water becoming infected through eelworms living on the roots of weeds growing on the banks being washed or scraped in. It would be a good practice therefore to erect a cheap wooden walk leading well into the river so that seed bed boys when drawing water will only take clear

water and not scrape their buckets against the banks. Oxen should not be permitted to drink from or near places where water is being drawn for seed bed purposes.

TREATMENT.

A. Where areas of infection are localised and small.—As has already been pointed out it would be to the advantage of the farmer under such circumstances to spend more than the thirty shillings per acre in order to prevent the spread of infection.

The best results are to be obtained by the use of chemicals.

The use of Cresylic Acid and Formaldehyde are referred to by Bewley(3). The former, namely, Cresylic Acid, should be used at the rate of one gallon (97—99% purity) mixed with forty gallons of water and applied to nine square yards of soil. The soil should be dug over as the chemical is applied and a second dressing of the same strength should be given a week later Bewley notes that it is not as efficient as steaming, but then steaming would be out of the question on most Rhodesian farms.

Bewley refers to the use of Formaldehyde at the rate of one gallon 40% Formaldehyde mixed with forty-nine gallons of water and applied to ten or eighteen square yards of soil and dug in one spit deep the same day. Heavier dressings are recommended where the disease has been severe.

The writer suggests that as soon as the infected plants (together with a border of, say, ten clean plants or an area ten yards deep surrounding the infected area) have been carefully removed with a hoe to prevent the roots from being damaged, the area should be ploughed and then sterilised by burning brushwood after the manner of sterilising seed beds. This done, the cold ashes should be removed and either Cresylic Acid or Formaldehyde be applied according to instructions given above. This treatment must be carried out as early as possible at the end of the growing season and the land should be ploughed at least once more prior to planting the following season's crop. It is further recommended not to plant tobacco the season following on this treatment but to grow a resistant crop.

B. Where areas of infection are large.—A comprehensive series of experiments are being carried out at the Trelawney Tobacco Research Station with a view to finding an efficient treatment applicable to Rhodesian conditions. Unfortunately the experiments are still in their infancy so that there is insufficient data to hand for advisory purposes, but farmers who have large areas infected are advised to restrain from growing, for at least three years, any of the crops listed in the Host List appearing at the end of this article. Any of the crops referred to in the Resistant List may be grown instead.

Short List of Hosts of Tobacco Root-Knot Eelworm.

Antirrhinum or snapdragon.
Balsam.
Beet(4).
Beans—Kaffir (*Vigna catjang*) and garden.
Cabbage.
Carnation.
Carrot.
Cauliflower.
Chrysanthemum.
Cosmos.
Cotton(5).
Cowpea—Most varieties except those enumerated in list of resistant plants.
Cucumber(4).
Potatoes.
Lettuce.
Peas—Garden pea (*Pisum Sativum*, L.)
Petunia.
Pigeon Pea (*Cajanus indicus*, Spreng).
Soya Beans—All common kinds grown in this country, including Biltan and Otoxi.
Sunflower.
Sweet Potatoes.
Tobacco.
Tomatoes.

Weeds.

Aerva leucura, Moq.
Aeschynomene minutiflora, Taub.
Amaranthus blitum, L.
Amaranthus graecizans, L.
Cleome monophylla, L.
Conyza sp.
Gynura cernua, Benth.
Hibiscus canabinus, L.
Orthosiphon bracteosus, Bak.
Polygala abyssinica, Fres.
Senicio sp.
Triumfetta sp.
Vernonia sp.

Short List of Plants reported to be Resistant.

Velvet Beans—Florida, Mauritius, Somerset.

Cowpeas—Monetta (almost invariably), Brabham and varieties of Victor and Iron.

Gaillardia(4).

Grasses—Natal Red Top, Rapoko, Teff, Rhodesian Sudan Grass.

Kaffir Corn.

Maize.

Marigold.

Munga.

Oats(5).

Peanuts—Most varieties, including Valencia, Virginia Bunch, Masumbika, Jumbo.

Soya Bean—Laredo variety.

Sunnhemp.

Wintersome.

Zinnia.

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CATTLE BALE or GRIP.

The export of chilled beef has brought the question of bruising prominently to the fore. Where cattle have to be "mouthed" before they are moved, there is a serious danger of bruising if proper equipment is not available to hold them and they are allowed to struggle.

These bruises spoil the appearance of the beef and, if serious, lead to the rejection of the carcases for export. Sometimes, however, the damage is internal and may escape the local inspector. In these cases the trouble is discovered when the quarter is cut up overseas and the beef is either returned to the agents or compensation has to be paid. Rhodesian beef in any case receives a poor advertisement.

Apart, however, from the question of bruising a good crush with a bale or grip is essential on any cattle farm where the cattle are not stabled. It facilitates the handling of the cattle, the dressing of wounds, castration, de-horning and so on.

The Department is indebted to Mr. R. C. Simmons, of Glass Block, Balla Balla, for the plan of the grip shown in figure 1, and to Mr. H. F. Gleadow, of Central Estates, for the one shown in figure 2. Both designs have given full satisfaction on the ranches where they are used.

Both grips are good, but the one shown in fig. 2 is probably the more effective for wild cattle and cattle with long horns. It looks more open to the oncoming cattle and they face up to it better. There is the danger, too, of a long horned beast edging partly through the grip No. 1 with its head sideways, before the tip of the second horn is cleared. It is then difficult to pull the gripping bar across in time to hold the animal. Grip No. 1 is, however, simpler of construction.

Construction Figure 1.—In this design two upright posts of 4 inch iron piping "A" and "B" are set in the ground at the end of the race leading from a crush and collecting pen. These posts are connected at top and bottom by horizontal cross

pieces "D" made of 3 inch piping secured by $\frac{5}{8}$ inch bolts. The single gripping bar "C" is hinged between the lower cross pieces by another $\frac{5}{8}$ inch bolt placed so that there is 6 inches clearance between the gripping bar, when standing vertical, and the post "B." The upper end of the gripping bar is slotted to receive the ratchet bar "E" which works on a hinge bolt as shown in detail on the drawing.

The ratchet bar rests in a slot at the top of the post "B" and the ratchet teeth engage with the inner side of the pipe at the bottom of the slot and hold it in the desired position when the bale is in operation.

Although iron piping is to be recommended for these parts of the structure on account of its durability, hardwood poles might be substituted and would give good service for a limited time.

Operation.—Each animal to be examined or treated is driven along the race until its head projects beyond the gripping bar when the latter is quickly drawn towards the post "B" by means of the ratchet bar so that the animal is held firmly by the neck.

Figure 2.—In this design of bale there are two gripping bars hinged by bolts at the bottom and linked together at the top in such a manner that they close in towards the centre when the hand lever is lowered.

The construction and method of working is quite clearly shown in the drawing and little further explanation is required. It should be understood that the central bolt which connects the extension of the hand lever and the links connecting the two side gripping bars must be adjusted so that it is free to slide up and down between the vertical guide bars. A large flat washer placed on each side of the guide bars and kept greased will prevent the mechanism jamming.

The gripping bars might with advantage be made of 3 inch iron pipe which could then be hinged at top and bottom with a single bolt passing through them or the same result could be attained by fitting the ends of the poles with ferrules of 3 inch piping about 6 inches long. There would then be no necessity for the separate hinge plates which are shown

bolted to the ends of the poles and the danger of the poles themselves splitting through the bolt holes would be removed.

General.—In both these drawings no extension of the race is shown beyond the grip. It is a good plan, however, to continue the race for a short distance and keep it closed at the end by slip rails. If an animal is missed by the grip it can be then driven back to the necessary position without having to be herded back to the collecting pen.

If the grip is not placed at the end of the race, as in the diagrams, there should be a gate in the side of the race just beyond the grip so that the operator can get at the head of the animal easily. It is also an advantage to have some of the poles behind the grip so fixed that they can be slid out and the back portions of the animal can be reached conveniently.

Tomato Culture in Southern Rhodesia.

By G. W. MARSHALL, Horticulturist.

Uses.—Tomatoes may be used for salads—mixed or plain; also cooked and served as a vegetable, stuffed with mince meats and baked; or converted into sauces, chutneys and jams, etc. They are also dried (sun or evaporated) and ground to a fine powder for flavouring soups and stews, etc. The many uses that the tomato may be put to adds greatly to its value, and it should find a place in every garden.

Soils.—There are few, if any of our soils that will not produce tomatoes. They may be grown successfully on soils ranging from sands to clays, but the intermediate soils (loams) are undoubtedly best and should be chosen where possible.

Manuring.—Where manure is used for growing tomatoes, it should be applied to the soil for the preceding crop, for if freshly applied it may encourage excessive leaf growth and reduce fruit production, and may also lower the resistance of the plant to disease.

The amount of manure to apply varies, but the average soil would require approximately one full wheelbarrow load or sackful to 15 square yards; this amount should be applied to the crop preceding the tomatoes, and it will then be sufficient for both crops.

Fertilising.—Tomatoes prefer an acid soil, and this soil condition may be maintained by the application of a liberal dressing of superphosphate.

Broadcast one to two pounds of ordinary high grade superphosphate, 17 per cent. to 19 per cent., P_2O_5, to each ten square yards of tomato soil. It should then be dug in as the beds are being prepared for planting.

Time to Plant.—Seed may be sown where no frosts occur at any season of the year, but as frost-free areas are fairly limited, plantings should be made to furnish winter and early summer crops. These out of season crops are usually more remunerative than those harvested at other seasons.

Seed may be planted in the frost-free zones at monthly intervals from February to December. The earlier plantings in the colder zones should be made in cold frames where they can be protected during cold nights.

Seed.—Home-grown seed is good if it is collected from healthy plants which produce good crops of large, fleshy fruit. The quality of the fruit from which the seed is collected is the determining factor in subsequent crops, and growers are consequently advised to plant nothing but the best of seed.

Most seedsmen catalogue and sell the popular varieties, and there is little or no danger of disappointment if the seed is purchased from a reliable seedsman.

Varieties.—Medium to large size, firm and fleshy red tomatoes are most favoured, and this type must be planted if the crops are to be marketed. Small and watery, as well as yellow varieties do not find a sale if the former types are available.

The following varieties will comply with the requirements of really good tomatoes: Marglobe; Bonny Best; Beauty; Best of All; and Earliana. Besides those enumerated, there are many others equally good and well worth testing.

Seed Sowing.—Seed may be sown either *in situ* or in seed beds. The former method of planting is only recommended during the rainy season. The "hills" should be spaced three feet by three feet and about ten seeds planted to each hill, and the plants thinned out to single plants when two or three inches in height.

When seed is planted in beds or tins it should be sown very thinly, or it will become necessary to prick the plants into other beds and tins. The best method to adopt, provided the seed bed is well prepared, is to plant the seed very thinly in rows three inches apart and then thin the seedlings when one to two inches high to two to three inches apart in the rows.

This will obviate any setback which may occur when pricking out, as the seedlings may then be lifted with a good ball of earth attached to their roots and transferred to their permanent positions.

Seed should not be covered with more than one-quarter of an inch of soil, and the beds should receive water every evening until the seed germinates—usually seven days.

Pricking Out.—It is necessary to prick out tomato seedlings which have been planted too thickly. The best stage of growth for this operation is when the plants are about one to one and a half inches in height, or when they have formed their second leaves. Many growers prefer to prick the seedlings into half petrol tins cut lengthwise; these tins are very suitable, and if filled three-quarters with good, loamy soil, they will take twelve to fifteen plants per tin—three rows or four or five plants each. This number of plants should not be exceeded, as closer planting produces spindly and delicate plants.

Seedlings may also be set in well prepared seed beds, usually at the same depth as they stood in the tins. The espacement of the seedlings may then be from one and a half by one and a half to three by three inches.

All seedlings must be watered immediately after they are pricked out, and then daily in the evening until well established. They can then be watered at intervals as or when required. Over-watering induces weak growth, which is detrimental to the health of the plants.

Transplanting.—The seedling plants may be transplanted when they are three to six inches in height, but care must be exercised in areas susceptible to frosts to see that the plants are adequately protected from injury. The plants will receive little or no check in their growth if they are lifted with a good ball of earth attached to their roots. The plants may be set slightely deeper than they stood in the seed bed; lanky plants may be set more deeply. Deep planting is not harmful, as the plant is capable of developing roots along the underground portion of the stem. If the plants are young and tender when transplanted and the season is hot, it may be advisable to pinch off at least half of the leaf surface, but not the terminal bud or immature leaves.

Distance to Plant.—The usual distance for planting tomatoes is three by three feet, but this distance may be increased if the soil is very fertile and strong growth is expected.

Hardening Off.—If plants are very tender—a condition produced through forcing in shady spots—they should be hardened off before planting in the field. The plants should be exposed gradually to outside or sunny conditions for at least a week; one hour's exposure may suffice for the first day, and then it can be increased daily until the plants are fit to transplant.

Staking and Pruning.—Training the plants to one or more stems or stakes is an advantage for home or commercial production. The stakes may be made of any saplings, reeds or split timber or bamboo, and should be at least five feet in length and one to one and a half inches in diameter. These stakes should be driven into the soil within a few inches of the tomato plants; then, as the plants commence to grow, they should be tied to these stakes with raffia or similar tying material. Weekly tying may be necessary to ensure good, straight stems. It is not advisable to retain more than three stems per plant; one is the usual number.

Shoots in excess of the desired number should be removed as they appear. This may be done at the time of tying. When the plants have reached the top of the stakes, the tips may be pinched out to speed up the setting and development of the fruit crop.

If the plants are set three by three feet, the stakes may be set as shown in the following diagram:—

TS	ST	S=Stake
TS	ST	T=Tomato plant

and the tips drawn together to form a small hut or tent frame. This system has many advantages, the chief of which is that the fruit crop, which is usually heavy, will hang on the under sides of the stakes, where they are protected from sun scald or other injury.

Watering.—As already stated, tomatoes do not require a great amount of water. This statement is verified by the volunteer plants to be seen in most gardens where they receive little or no water and produce good crops of fruit. All plants should receive a fairly liberal amount of water after transplanting, until they are established. Weekly applications of, say, one gallon per plant for the first month, then fortnightly applications of two gallons per plant until the fruiting stage, after which four gallons may be given each fortnight. Overwatering produces very rapid growth, and the plants are more susceptible to disease.

Cultivation.—Cultivation must be frequent and thorough. The soil surrounding the plants should be loosened after each watering.

Harvesting.—Tomatoes for marketing should be harvested when they commence to turn colour, for if harvested perfectly green, they lose flavour, and, although they become a normal colour, they are unsaleable. Tomatoes may be harvested with their stems attached. They then have a nicer appearance, but care must be exercised that the stems are clipped well up against the fruit to prevent injury to the other tomatoes packed in the same containers.

Grading.—All tomatoes for marketing must be graded to uniform sizes, as ungraded tomatoes are difficult to pack and considerable waste is likely to occur in the stores where the ungraded fruit is continually being picked over.

Packing.—The usual size of a tomato box is 18 inches by 9 inches by 5 inches outside measurements, and it holds about 10 lbs. of fruit. Other boxes may be used, but not larger than half petrol cases, which hold 25 lbs. of tomatoes.

All boxes must be packed firmly; this prevents fruit movement and injury while in transit to markets. Fill all boxes with fruit and not with packing material—wood-wool, etc.

Rotation.—Tomatoes must be rotated with other crops, and care must be exercised that they do not follow potatoes, which are susceptible to diseases affecting tomatoes.

A suggested rotation would be as follows:—

1. Manured cabbage crop;
2. Unmanured tomato;
3. Manured lettuce;
4. Unmanured carrots;

or—

1. Manured lettuce;
2. Unmanured tomato;
3. Manured peas;
4. Unmanured beans;
5. Manured potatoes.

Insect Pests.—Space does not permit of dealing with this factor, but it may be stated that the tomato in this country is singularly free from pest injury. A few leaf and fruit-eating insects are at times troublesome, but hand collecting is usually sufficient to control them.

Diseases.—Tomatoes are susceptible to several diseases, but mainly blight, stem-end rot of the fruit or mosaic. As most of the diseases are incurable, it is advisable to adopt the adage "prevention is better than cure." Spray the plants fortnightly with Bordeaux Mixture at a strength of 4.4.50.

The Feeding of Phosphorus Supplements to Growing Cattle.

By C. A. MURRAY and A. E. ROMYN.

Summary.—An experiment was carried out to check the results previously obtained from the feeding of a phosphorus supplement to young cattle and to determine whether the animals would respond to the feeding of bonemeal where they had not responded to the feeding of dicalcium phosphate.

In the event of a response to the feeding of bonemeal, plans were made to determine whether such response could be attributed to the protein in the bonemeal.

Four similar groups of weaner steers were used in the experiment and fed over a period of 25 months. Group I. (Control) received veld grazing only, Group II. veld grazing plus 1 oz. dicalcium phosphate, Group III. veld grazing plus 3 ozs. bonemeal and Group IV. veld grazing plus $\frac{3}{4}$ oz. bloodmeal per head per day.

Throughout the experiment there was no significant difference in weight or height between any of the groups and it was concluded that:—

(*a*) The animals did not benefit from the feeding of phosphorus either in the form of dicalcium phosphate or bonemeal.

(*b*) The natural grazing, where the animals had access to browse, apparently supplied a sufficiency of phosphorus for the growth of young animals.

Description of Experiment.—As a result of a series of experiments carried out by the writers(1) during the years 1932 to 1935 it was concluded that the sandveld pastures in the Matopos area supply sufficient phosphorus to satisfy the requirements of young growing cattle maturing at the rate of

the cattle in the experiment and that the feeding of bonemeal, dicalcium phosphate and other phosphorus supplements to young growing cattle was, therefore, not necessary.

In the experiments referred to dicalcium phosphate at the rate of $\frac{2}{3}$ oz. per animal per day was fed as the phosphorus supplement. At that time it was the cheapest source of phosphorus available, and was therefore used instead of bonemeal. According to the work of du Toit and Green([2]), $\frac{2}{3}$ oz. dicalcium phosphate satisfied the phosphorus requirements of grazing cattle in Bechuanaland and was equivalent to 2 to 3 ozs. of bonemeal.

A number of cattle farmers in Matabeleland, however, who had been feeding bonemeal liberally to their cattle found it difficult to accept these negative results obtained from dicalcium phosphate as they felt that their cattle had benefited very much from the feeding of bonemeal.

It was noted by the writers that all the cases where a response to the feeding of bonemeal was claimed the animals had been given free access to unlimited supply of this mineral supplement. It is well known that when the feeding of bonemeal is not controlled some animals will take excessively large quantities,* it was thought, therefore, that the response claimed for the feeding of bonemeal might be due to the protein contained in the bonemeal† and not to the phosphorus supplied.

This experiment was, therefore, planned as a demonstration of the comparative values of dicalcium phosphate and bonemeal and to determine, at the same time, whether the protein in the bonemeal was a factor of importance in comparing two mineral supplements.

Experimental Animals.—Forty-four uniform ranch-bred grade Hereford weaner steers were obtained from the Nuanetsi Ranch. They were 12 to 14 months old at the commencement of the experiment on the 17th April, 1934.

*Some young animals were observed to take up to one pound of bonemeal per day and one cow was found to consume nearly 7 lbs. in one day and was, and remained, in perfect health and condition.

†Analyses by the Division of Chemistry, Department of Agriculture, Salisbury, showed bonemeal to contain 21 per cent. of crude protein.

Records Kept.—Throughout the experiment the weights of the steers and the height measurements at the withers were taken at 28-day intervals. The method followed was that of Eckles([3]).

At different periods all the animals were bled and the blood analysed for inorganic phosphorus according to the method of Green([4]) as modified by Malan and Van der Lingen([5]).

General observations on the health, etc., of the animals were also kept.

Groups.—The forty-four weaners were divided into four similar groups of 11 per group and given the following rations:—

Group I.—Veld grazing only. (Control).
*Group II.—Veld grazing plus 1 oz. dicalcium phosphate ($CaHPO_4$) per head per day.
*Group III.—Veld grazing plus 3 oz. bonemeal per head per day.
†Group IV.—Veld grazing plus ¾ oz. bloodmeal per head per day.

Management and Feeding.—Throughout the experiment the animals were grazed together. Every morning, except Sundays, they were collected at the crush pen in the paddock in which they grazed and each animal hand fed its ration of either dicalcium phosphate, bonemeal or bloodmeal. After feeding, they were immediately turned out to graze until the next morning.

RESULTS.

Growth Data.—The average weights and heights of the four groups of steers at 28-day intervals are given in Table I., from the 17th of April, 1934, to the 15th of May, 1936, *i.e.*, for two years and 28 days.

*It was previously pointed out that according to the work of du Toit and Green ([2]) two-thirds oz. dicalcium phosphate was the equivalent of two to three oz. bonemeal when fed to young growing stock on the phosphorus deficient pastures of Bechuanaland. Subsequent work by Malan and du Toit([6]) showed that the most satisfactory daily quantities of these two supplements were one oz. and three ozs. of dicalcium phosphate and boneamel respectively.

†Estimated to contain the same quantity of digestible protein as 3 oz. of bonemeal.

TABLE I.—*Average Weights and Heights of Steers at 28-day intervals.*

Date.	GROUP I. Control—Veld grazing only.		GROUP II. Veld grazing plus 1 oz. Dicalcium phosphate daily.		GROUP III. Veld grazing plus 3 oz. Bonemeal daily.		GROUP IV. Veld grazing plus ¾ oz. Bloodmeal daily.		
	Weight.	Height.	Weight.	Height.	Weight.	Height.	Weight.	Height.	
	lbs.	ins.	lbs.	ins.	lbs.	ins.	lbs.	ins.	
17/ 4/34	454	43.1	453	43.1	455	43.0	455	43.1	1st Winter.
16/ 5/34	456	43.1	454	43.3	457	42.9	463	43.2	
13/ 6/34	455	43.8	450	43.5	446	43.6	458	43.5	
11/ 7/34	453	43.4	449	43.4	443	43.3	461	43.5	
8/ 8/34	436	43.3	437	42.9	424	42.9	449	43.2	
5/ 9/34	437	44.2	426	43.9	424	44.0	434	44.5	
3/10/34	433	44.0	428	43.4	426	43.8	439	44.1	
31/10/34	420	43.8	414	43.4	408	43.5	422	43.6	
28/11/34	404	43.6	396	43.4	376	43.1	395	43.7	
27/12/34	461	44.1	458	43.7	432	43.2	456	44.1	1st Summer.
23/ 1/35	503	44.5	497	44.5	469	44.2	506	44.6	
21/ 2/35	597	44.8	596	44.7	558	44.5	602	45.1	
20/ 3/35	642	45.1	642	45.5	611	45.2	645	45.7	
17/ 4/35	664	45.6	660	45.8	633	45.3	669	45.9	
16/ 5/35	686	46.5	682	46.4	646	46.0	685	46.6	
13/ 6/35	668	46.9	667	46.7	633	46.3	674	47.3	2nd Winter.
11/ 7/35	646	46.7	657	47.0	614	46.4	655	46.9	
7/ 8/35	636	46.9	633	46.9	595	46.3	641	46.9	
5/ 9/35	628	47.1	627	46.9	586	47.2	639	47.1	
3/10/35	590	47.4	591	47.0	547	46.7	603	47.2	
5/11/35	567	46.9	563	46.9	530	46.5	576	46.7	
27/11/35	562	46.2	562	46.7	524	46.2	571	46.6	
3/ 1/36	481	47.0	475	46.4	446	46.1	488	47.0	
23/ 1/36	606	46.4	602	46.9	580	46.1	616	47.0	
26/ 2/36	693	47.0	689	46.7	661	46.1	702	46.9	2nd Summer.
18/ 3/36	745	47.5	747	47.5	717	46.9	750	47.7	
15/ 4/36	815	47.8	821	48.0	788	47.6	831	48.2	
15/ 5/36	821	48.0	818	48.0	785	47.6	828	48.10	

These data are shown in graphic form in figures 1 and 2.

The inorganic phosphorus content of the blood of the experimental animals was determined at seasonal intervals. The results are shown in Table II.

TABLE II.—*Millegrams, Inorganic Phosphorus per* 100 *c.c. blood.*

Period.	Date.	Group I.	Group II.	Group III.
First Winter	29. 9.34	5.0	5.4	5.4
First Summer... ...	25. 1.35	6.0	6.9	6.3
Second Winter... ...	30.10.35	4.3	5.5	5.5
Second Summer ...	7. 5.36	5.2	5.5	6.0
Average		5.1	5.8	5.8

Discussion.—From a study of Table I. and of figures 1 and 2 it is clear that the average weights and heights of Group I. (Control), II. (Dicalcium phosphate), and IV. (bloodmeal) where practically identical throughout the experiment and at no time was there any indication that any one of these three groups did better than either of the other two. In addition to this, there were at no time any visible differences in appearance between the three groups.

It appears quite definite, therefore, that the animals in Groups II. and IV. derived no apparent benefit from the feeding of dicalcium phosphate and bloodmeal respectively.

The bonemeal fed Group (Gr. III.) did not do as well as either the Control, dicalcium phosphate or bloodmeal group. A careful statistical analysis showed, however, that the small differences that appeared to exist between this group and the other three groups, during various stages of the experiment, were not significant. In other words, they cannot be ascribed to the bonemeal fed but were due to chance variations.

The weights of the cattle and the rate of growth in the three groups are considered normal for ranch cattle, which are not given any supplementary feeding or hay on sandveld in this Colony during the winter months.

From Table II. it will be seen that the average inorganic phosphorus values for Group I., II. and III. were 5.1, 5.8 and 5.8 respectively. The feeding of dicalcium phosphate and bonemeal raised the inorganic blood phosphorus of the animals in Group II. and III. above that of the control group. But this is not an indication that the Group I. animals suffered from a phosphorus deficiency as according to the work of Malan, Green and du Toit and others ([7], [8]), and the results of our previous experiments([1]), an inorganic phosphorus level of 5.1 m.g.m. per 100 c.c. falls well within normal limits for blood phosphorus. Even the value of 4.3 obtained for Group I. on the 30th October, 1935 (during the worst time of winter) does not indicate a deficiency, and it is very much above the very low levels obtained in areas where cattle suffer from a phosphorus deficiency. It appears that the animals in Groups II., III. and IV. derived no benefit from the daily feeding of 1 oz. dicalcium phosphate, 3 oz. bonemeal or $\frac{3}{4}$ oz. bloodmeal respectively, and that the effect of bonemeal as phosphorus supplement was not different from dicalcium phosphate. The amount of protein supplied in bonemeal, as shown by the results from Group IV. was too small to affect the growth of the animals at any time of the year.

The results of this experiment confirm those prevoiusly reported, *i.e.*, that the pastures in Matabeleland, with normal amount of browsing, apparently supply sufficient phosphorus for the growth of young cattle.

REFERENCES.

(1) Murray, C. A., and Romyn, A. E., *et. al.* (1936).—The Supplementary Feeding of Mineral and Protein Supplements to Grazing Cattle in Southern Rhodesia and its Relation to the Production of Beef Steers. *Rhod. Agr. Jour.*, Vol. XXXII., No. 6.

Figure 1.

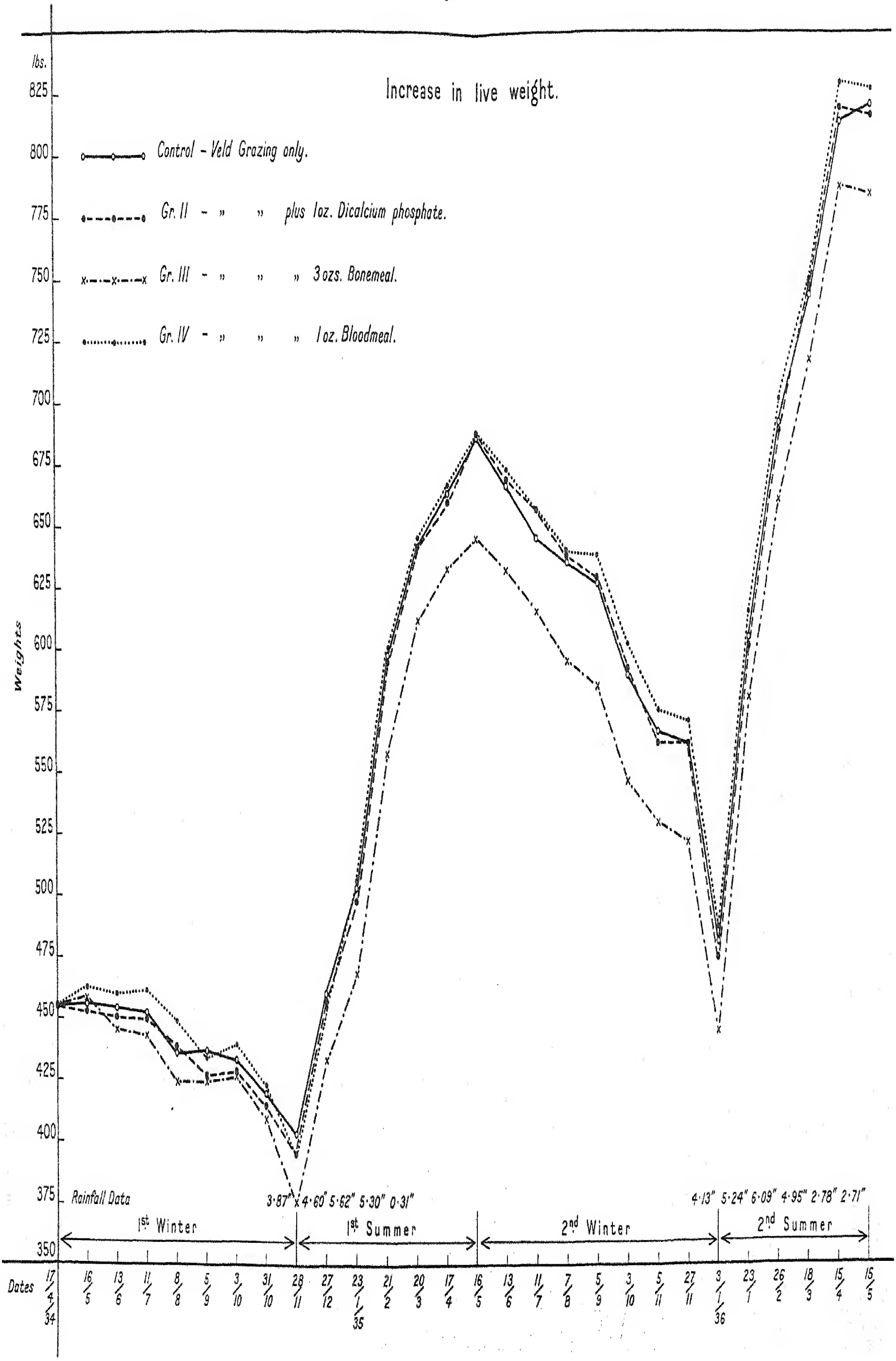
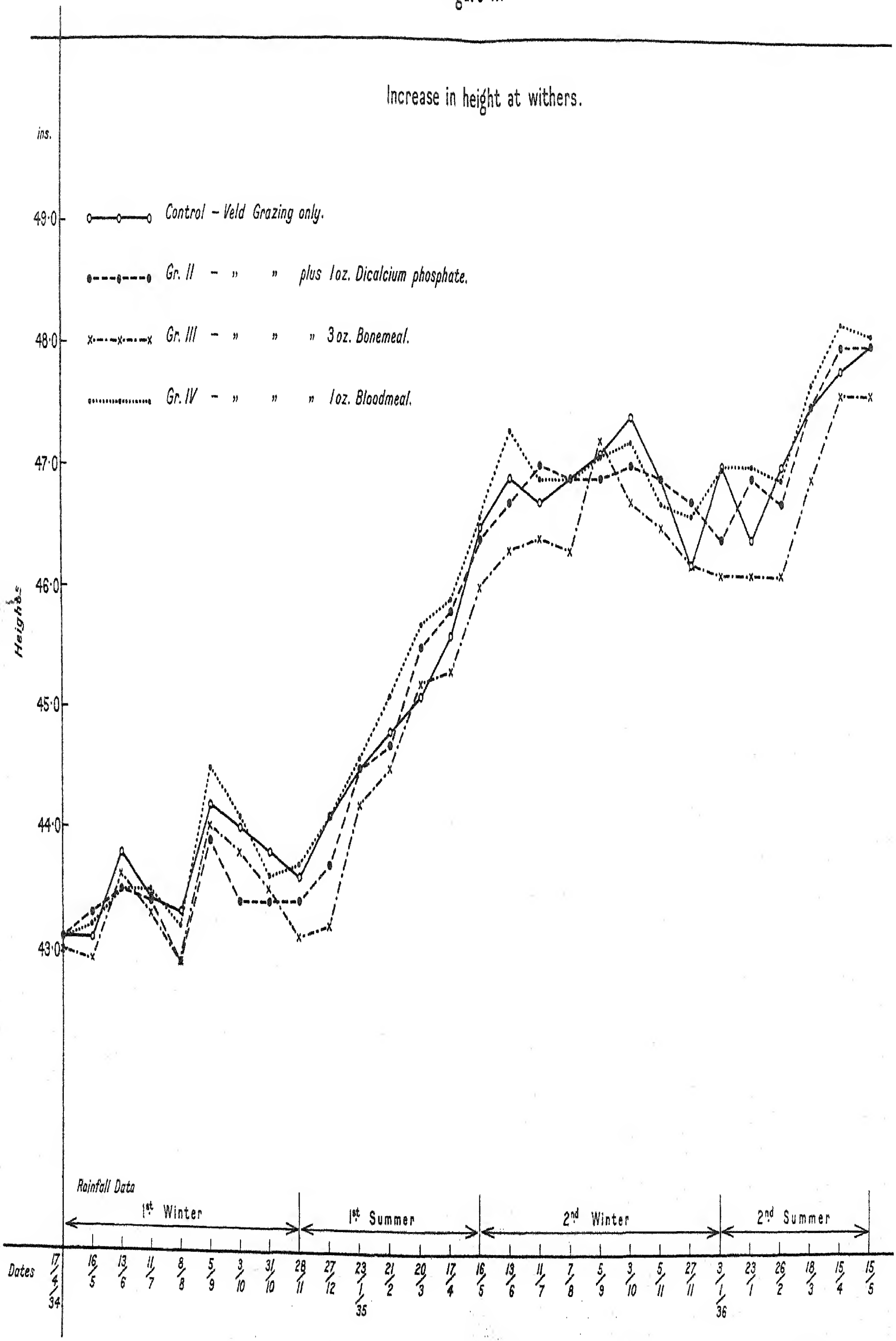

Increase in live weight.
lbs.
Control - Veld Grazing only.
Gr. II - " " plus 1oz. Dicalcium phosphate.
Gr. III - " " " 3ozs. Bonemeal.
Gr. IV - " " " 1oz. Bloodmeal.
Weights
825
800
775
750
725
700
675
650
625
600
575
550
525
500
475
450
425
400
375
350
Rainfall Data
3·87" 4·60" 5·62" 5·30" 0·31"
4·13" 5·24" 6·09" 4·95" 2·78" 2·71"
1st Winter
1st Summer
2nd Winter
2nd Summer
Dates
17/4/34
16/5
13/6
11/7
8/8
5/9
3/10
31/10
28/11
27/12
23/1/35
21/2
20/3
17/4
16/5
13/6
11/7
7/8
5/9
3/10
5/11
27/11
3/1/36
23/1
26/2
18/3
15/4
15/5

Figure II.


Increase in height at withers.
ins.
49·0
48·0
47·0
46·0
45·0
44·0
43·0
Heights
Control – Veld Grazing only.
Gr. II – " " plus 1 oz. Dicalcium phosphate.
Gr. III – " " " 3 oz. Bonemeal.
Gr. IV – " " " 1 oz. Bloodmeal.
Rainfall Data
1st Winter
1st Summer
2nd Winter
2nd Summer
Dates
17/4/34
16/5
13/6
11/7
8/8
5/9
3/10
31/10
28/11
27/12
23/1/35
21/2
20/3
17/4
16/5
13/6
11/7
7/8
5/9
3/10
5/11
27/11
3/1/36
23/1
26/2
18/3
15/4
15/5

1. Application of caustic potash pencils.
2. Actual cautery with hot iron.

The object in both methods is to destroy the horn-forming cells before any appreciable development takes place, and thus entirely prevent the growth of horn.

Young Cattle: 1. Application of Caustic Potash Pencils.—This method, in the writer's opinion, is to be recommended above all others, being the simplest, cheapest and most satisfactory.

No instruments beyond an ordinary pocket knife are required, and the caustic potash pencils can now be purchased almost anywhere throughout the Colony.

Age.—The best age is when the calf is from 5 to 10 days old, or as soon as the small horn buds make their appearance, which is usually under a week old.

Restraint.—The calf should either be held in the standing position or it may be thrown, it is immaterial as long as the head is held rigid.

Procedure.—The operation should not be performed in the open in wet weather, as the rain will cause the caustic to run from the wound down the face and into the animal's eyes; other than this weather conditions have no effect.

It is better if the hair immediately around the horn bud is removed by scissors; this is not essential, but the hair must be brushed aside so as not to interfere with the operation.

The horny skin covering the budding horn, together with the small portion of the horn protruding above the level, is removed in one movement with a knife, for which purpose a blacksmith's "searcher" is especially adaptable, but the ordinary pocket knife is quite suitable. Some operators manage without any knife, using their thumb nail only.

A deep scooping or digging cut should not be made owing to the danger of opening into the frontal sinus and also causing excessive haemorrhage, which, although in itself is quite harmless, is to be avoided owing to the danger of excessive moisture caused by the blood overflowing the wound and getting into the animal's eyes whilst the caustic pencil is being applied.

Having made the necessary cut, the caustic pencil is now applied by rubbing the point over the entire cut surface in a rotary manner.

It is important that the entire cut surface be cauterised, otherwise live cells may be left around the edges and later develop into odd shaped horny growths, which although small and harmless, are very unsightly and spoil the appearance of the animal as a de-horned beast.

The caustic pencil is applied until the cut surface becomes a pale glistening white, this effect is usually obtained by rubbing the wound about 15 times—this, of course, is not a hard and fast rule and is only mentioned as a guide to those attempting the operation for the first time.

The astringent effect of the caustic will usually check all bleeding caused by the cut, but great care must be exercised to see that none of the caustic overflows into the animal's eyes or skin surrounding the wound. A ring of vaseline placed round the wound will assist in preventing this.

The caustic on the wound having dried the animal may be freed and allowed open range, provided the weather is dry; if wet the calf must be kept under cover.

If the operation is properly carried out no bad effects result and not a vestage of horn will subsequently develop, and the animal will grow out indistinguishable from polled breeds of cattle.

After the operation the animal should be occasionally examined for the presence of screw worm, and if found, suitable measures taken.

In the ordinary way the surface of the wound becomes hardened and screw worm will not gain access. Occasionally, however, through accident or by the animal rubbing its head against some obstacle, the wound may become opened with resulting haemorrhage, thus attracting flies, etc.

2. **Actual Cautery with the Hot Iron.**—The use of the hot iron is not a new method, but is probably almost the oldest known, however, both the technique and the instruments used have been improved.

1. **Hand Saw.**—Although special de-horning saws are obtainable, these are not essential and any variety of hand saw will suffice, provided it is reasonably sharp.

The animal must be cast and a general anaesthetic administered. The horn is then sawn off as near the base as possible.

Extensive haemorrhage always occurs and must be controlled before the animal is freed; this is best accomplished by the application of cotton wool pads soaked in any suitable disinfectant, such pads are placed on the horn stump and kept in place under pressure by means of a figure of eight bandage applied round the base of the horn stumps.

These pads and bandages may remain *in situ* for three days, when they must be removed and, if necessary, replaced by fresh ones, or if fresh pads are not necessary, the stumps of the horns should be smeared with stockholm tar and the patient turned loose.

Some operators smear the bleeding surface of the horn stumps with the actual cautery before applying the pads and bandage, but this procedure is according to the operator's individual taste.

As bleeding may recur through injury received before the wounds have properly healed, the animal must be periodically examined for this and for the presence of screw worm.

2. **De-horning Shears.**—Various types of instruments known as de-horning shears are manufactured for the de-horning of cattle, most are heavy, cumbersome instruments and require expenditure of considerable physical force in their use. They are also quite expensive, costing from £3 to £10, according to design. The principal of all designs is the same and consists of one or more cutting knives brought into use under pressure, on the bolt cutting principle. The knives are fixed in the head of the instrument and the pressure applied by bringing the handles together. In the larger sizes the handles may be some four feet long fitted with cogs.

To use the instrument the handles are pulled apart, the head of the de-horner is placed over the horn as near the

base as possible, the handles are then pulled together, which closes the instrument and causes the blades to cut into the horn. Continued pressure is applied until the horn is completely sheared through. Haemorrhage similar to that met with in the use of the saw will occur and must be controlled in the same way.

Care must be exercised that an even pressure is maintained, as with any jerky or uneven pressure there is danger of drawing the horn core away from its attachment to the skull, thus exposing a large cavity some two inches or more in diameter leading into the frontal sinuses. Such a wound is difficult to keep clean, and invasion by screw worm and other parasites usually follows. If the frontal sinuses are opened, bleeding *via* the nose will be encountered which, although not serious, greatly retards healing and causes inconvenience to both animal and owner.

It must be pointed out that instruments such as those just described are not intended for the wholesale de-horning of cattle, but are designed to meet cases of accidental injury to horns necessitating amputation or removal of horns from savage and dangerous cattle. The use of these instruments, in my opinion, holds no advantage over the use of the hand saw.

In conclusion, the importance and necessity of de-horning cattle intended for slaughter cannot be too strongly emphasised, or the fact that they should be done early in life as calves.

Relative Value of Different Forms of Nitrogen for Tobacco.

By F. A. Stinson.

(*Note.*—The following is taken from a paper presented at the Annual Tobacco Fertiliser Conference held at Simcoe, Ontario, in November, 1936, and reported in *The Lighter.*)

Since nitrogen is the most expensive component of the fertiliser mixture, its use should be well understood. The availablity of the nitrogen for tobacco is quite important, because the plant takes up its supply in a relatively short time. Very little over one hundred days are ordinarily occupied for growing the crop. Data are available from work conducted to show that approximately thirty pounds of nitrogen are taken up in producing flue-cured tobacco at the rate of 1,000 pounds per acre. Recent investigations show that when the plant has organised about half of its total dry weight some 80 per cent. of its nitrogen has been absorbed. This would indicate that the question is largely one of availability which depends to a considerable extent on the form of nitrogen supplied.

When there is a deficiency of available nitrogen the leaves are light green in colour, and if this condition is prolonged with sufficient severity the bottom leaves may dry up and turn brown. The yield of cured leaf is reduced and, although it is usually bright in colour, it lacks length, body and texture. An excess of available nitrogen gives a heavy rank type of growth; the leaf will not cure properly and will be rough, have an undesirable colour, and be unfit for cigarette purposes. Excessive nitrogen delays maturity, a factor of major consideration in Ontario. It is desirable that there should be sufficient reduction in the supply of available nitrogen just previous to the time of harvesting to stimulate a fading out of the dark green colour, as tobacco ripens best under this condition.

Since the nitrogen in the soil is mostly in the organic form, the supply available to the plant will depend on how favourable conditions are for decomposition and nitrification, and also on the amount and form of nitrogen added in fertiliser. The continued use of legumes to build up the nitrogen of soil, while quite effective for general crops, has not proved satisfactory for flue-cured tobacco. The use of manure and cover crops for adding organic matter is effective, but should be used with discretion. The nitrogen in well-rotted manure is more readily available to the plant than that in fresh manure. The percentage of nitrogen in manure varies widely.

Nitrogen supplied in commercial fertiliser may be classified as follows: organic and inorganic, or organic and water-soluble.

It is generally recognised that nitrogen is assimilated by the plant largely in the form of nitrates and possibly to a slight degree in the form of ammonia. To become available to the plant, therefore, organic nitrogen must first become decomposed in the soil and pass through various stages to form nitrates.

The value of different sources of nitrogen may be considered from a number of angles. These are summed up as follows:—

(1) The possibility of a certain source supplying nitrogen to the plant in a peculiar form.

(2) The rate of availability of the nitrogen in the source supplied.

(3) Secondary effect of the source on the soil or the plant: as, effect on the pH value, toxicity to the plant.

(4) Secondary effects of the nutrients other than nitrogen which are supplied in the nitrogen carrier; for example, the superiority of cottonseed meal has been shown on certain soils to be owing to its content of magnesium. This refers to cigar tobacco where 160 pounds of nitrogen were applied per acre in a 4—4—5 formula.

(5) Effect on ultimate yield and quality of leaf when tested under local conditions.

The last of these should include all the others and furnish to ultimate criterion of value. Regarding the possibility of certain sources supplying nitrogen in a peculiar form, workers in Connecticut stated in 1935 that the nitrate is the same form from whatever sources it is derived and, therefore, should have the same effect on the plant. They surmised that if the differences in effect on the plant which were claimed did exist, such differences must be due to different rates of becoming available or to subsidiary elements that enter the roots with the nitrogen. Another American worker found that any special virtue which cottonseed meal may possess as a fertiliser, apparently, is not based on any peculiar form of nitrogen it contains. Most authorities on nutrition of tobacco seem to hold this general opinion.

The nitrogen in the inorganic sources generally becomes available more rapidly than that in organic sources. Nitrogen in urea becomes available more rapidly than in other organic sources. The nitrate forms of nitrogen are the most rapidly available, followed by ammonia. Soil moisture, temperature, and acidity, and the amount and kind of organic matter present are among the factors affecting the rate of availability of nitrogen. While it is desirable to have a large amount of available nitrogen present in the early-growth stage of the plant, it must be remembered that the more available the nitrogen is the greater the danger of loss from leaching during rainy weather. When a large portion of the nitrogen has been leached the plant may suffer from lack of nitrogen at a later stage. On the other hand, if weather is cold the nitrogen in the less available forms may not become available to the plant. It has been pointed out repeatedly that the reaction of the soil affects the rate of availability of various forms of nitrogen. To insure a continued supply of nitrogen for the plant it would appear that a number of sources of nitrogen, varying in their rate of availability, would be most satisfactory.

It is known that different nitrogen carriers vary greatly in their effect on the pH value of the soil. For instance,

during ten years in Connecticut nitrate of soda applications did not change the soil reaction, sulphate of ammonia made the soil much too acid to produce good tobacco, and all of the organic sources had lowered the pH value considerably. In a number of cases American workers have reported that nitrate of soda was a considerably better source than sulphate of ammonia when no lime was used, but when limestone was applied to correct the acidity there was very little to choose between the two sources. The effect of the various carriers on the acidity of the soil is apparently worthy of serious consideration.

In Maryland in 1934 it was reported that when forty pounds of nitrogen were supplied by cyanamid there were distinct symptoms of toxicity on the plants, although this effect was not noticeable when used to supply only twenty pounds of nitrogen. When calcium cyanamid was used to supply up to fifteen pounds of nitrogen per acre in a test at Delhi during 1936, no visible symptoms of toxicity were apparent.

Differences in the value of various sources or nitrogen may be due to the effect of secondary nutrients in such sources. For example, sources of plant origin carry more magnesium than sources of animal origin, while the former are lower in iron. Ammonium sulphate has been shown to furnish too much sulphur under some conditions, while ammonium chloride cannot be used exclusively on account of the effects of chlorine. Dr. Garner, of the United States Department of Agriculture, in 1934, referring to conditions in that country, stated that in considering the value of the various synthetic forms of nitrogen due consideration must be given to the supply of magnesium, calcium, chlorine, and sulphur available to the plant. While the supply of these nutrients has not been demonstrated as of major consideration under Ontario conditions, there is no assurance that it will not in the future.

Trends in Results of Experiments. Experimental evidence obtained at the Sub-station at Delhi over the three-year period showed an improvement in quality as the proportion of organic nitrogen, in the form of dried blood, was increased from none up to one-half of the total nitrogen.

Table I.—The effects of varying the proportion of different forms of Nitrogen on the yield and grade index of Flue-cured Tobacco.

Approximate proportion in fertiliser.	Nitrate of Soda. Nitrate Nitrogen		Ammonical Nitrogen Sulphate of Ammonia.		Organic Nitrogen Dried Blood.	
	Yield.	Gr. Index.	Yield.	Gr. Index.	Yield.	Gr. Index.
%	lb.	%	lb.	%	lb.	%
0	1,685	28.73	1,698	30.16	1,615	29.64
25	1,552	29.07	—	—	1,713	30.36
50	1,615	29.64	1,552	29.07	1,529	35.87
75	1,518	31.85	1,496	28.08	—	—
100	1,698	30.16	1,685	28.73	—	—

Note.—Results of the year 1935 only.

It would appear from the above table that at least one-quarter of the total nitrogen should be supplied in the organic form for optimum results. In 1936 at Delhi a comparison was made between 2—10—8, in which half the nitrogen was water-soluble, and a 1—10—8, in which all of the nitrogen was water-soluble. Although the yield and quality data are not yet available, observations in the field would indicate that considerable use was being made of the organic nitrogen since these plants were larger and had a darker green appearance and ripened more slowly than those which received one per cent. water-soluble without any organic nitrogen.

A comparison of soybean meal, dried blood, tankage, and cottonseed meal did not demonstrate the superiority of any particular one as a source of organic nitrogen. Nitrate of soda gave better average results than other sources of inorganic nitrogen when used as the sole source of water-soluble nitrogen. Sulphate of ammonia has given comparatively poor average results when used as a single source to furnish the water-soluble portion of the nitrogen, but has been quite satisfactory in combination with nitrate of soda. Nitro-chalk has proved a promising source during the two years it has been in the test; calcium nitrate is rated low as a source of nitrogen on the Delhi Station soils.

Striking differences in appearance of the tobacco on different nitrogen treatments at Delhi during 1936 were not evident in the field; however, certain observations seem worthy of mention. The plants which received calcium nitrate and sulphate of ammonia appeared below average in growth and spread. The plots in which nitrate of soda was used singly and in combination appeared superior to the average in growth and evidence of quality.

The series of comparisons of different sources of nitrogen at Delhi has not been in progress for a sufficient length of time to establish any definite trends or detect accumulative effects. For instance, it may or may not be significant that sulphate of ammonia gave results superior to nitrate of soda in the first crop and that the order was reversed on the second crop on the same location. It is the unfortunate truth that weakness in certain fertiliser and cultural practices is not evident when first used, but are manifest only after they have become established and the effect has become sufficiently accumulative to result in serious loss. In the meantime, it is important that use be made of all available information so as to guard against unsound practices.

Report of the Tobacco Research Board

FOR THE YEAR ENDING DECEMBER 31st, 1936.

(Continued.)

By CHAS. K. BRAIN, M.A., D.Sc., Director of Agriculture and Chairman of the Tobacco Research Board.

NITROGEN EXPERIMENTS.

General.—It has been found in other countries that the type of nitrogen supplied exercises a marked effect upon the quality of the cured leaf. Accordingly, an experiment was designed to test this fact under Rhodesian conditions. At the same time the effect of lime was investigated by adding this material to half the plots and omitting it from the other half so that by a direct comparison of these two series the total overall effect of this mineral could be estimated. Further, the effect within the nitrogenous treatments could also be evaluated, as will be shown. The phosphorous and potash remain constant throughout the experiment, the only variables being the quantity and type of nitrogen.

Three levels of nitrogen were tested:—

1. No nitrogen.
2. 14 lbs. nitrogen per acre=200 lbs. 20—7—10 (single dose).
3. 28 lbs. nitrogen per acre=200 lbs. 20—14—10 (double dose).

Four types of organic nitrogen were also tested:—

1. Bloodmeal.
2. Cyanamide.
3. Urea.
4. H.O.P. fishmeal fertiliser.

In accordance with the usual fertiliser practices these organics supplied one-third of the total nitrogen, the remainder being given as sulphate of ammonia. This proportion of organic to inorganic nitrogen was kept both at 14 and 28 lbs. nitrogen per acre.

Lime was applied at 5 cwt. per acre. Thus in all there are 3 x 4 x 2=24 treatments.

Fertiliser Procedure.—(*a*) *Basal Dressing.*—Since the experiment was essentially a test of quantity and quality of nitrogen all plots were given a basal dressing of potash and phosphorus corresponding to 200 pounds of fertiliser mixture analysing 20—7—10 (with, of course, the nitrogen omitted).

(*b*) *Application of Nitrogen.*—The plots receiving no nitrogen had nothing further added to them. The remaining treatments received single or double quantities of the various types of nitrogen supplied.

(*c*) *Lime.*—The requisite quantity of lime was applied after the nitrogenous dressings and the plots immediately ridged.

(*d*) *Method of Application.*—The individual ingredients composing the various fertiliser mixtures were weighed and carefully mixed up on a concrete floor. The mixtures were applied by hand round the straw.

Note on H.O.P. Fishmeal.—Since fishmeal itself contains phosphorus and potash (in fact, the makers claim it to be a balanced fertiliser) the amounts of double supers, muriate and sulphate of potash were correspondingly decreased. In the double dressing of fishmeal no potash had to be added; in fact, there is an amount of 10 lbs. per acre present as sulphate over and above that contained in the other dressings.

Field Layout.—The experiment was laid down on second year land, which had carried maize the first year, in four randomised blocks with four replications. Owing to a special method of layout the 24 treatments were able to be compared four times in an area little over one acre. All plots were 10 x 12, or one-fortieth acre.

The arrangement, together with the yields from each plot in pounds in cured leaf, is given below:—

O=basal dressing of potash and phosphorus only.
1=basal dressing+single dose of nitrogen 14 lbs. per acre.
2=basal dressing+double dose of nitrogen 28 lbs. per acre.
U=organic nitrogen as urea.
B=organic nitrogen as bloodmeal.
Cy=organic nitrogen as cyanamide.
F=organic nitrogen as Humber H.O.P. fishmeal.
Ca=additions of lime at 5 cwts. per acre.

Field Observations.—The planting out, cultural and reaping dates are:—

Planting out.—December 16th.
Primed and cultivated.—January 18th.
Topped and suckered.—February 15th.
1st picking.—February 20th.
2nd picking.—March 10th.
3rd picking.—March 26th.
4th picking.—April 4th.
5th picking.—April 24th.

On January 22nd, five weeks after planting out, the differences between the different nitrogenous levels were very apparent. All these plots which had received 28 pounds of nitrogen to the acre were noticeably darker in colour (with one exception, the final plots) than those which had received only 14 lbs. The most striking difference was between these latter and those to which no nitrogen had been given. The no nitrogen plots were very light in colour, but at this stage appeared to be as advanced as the nitrogen series.

The immediate availability or urea was well shown up by the dark green colour of these plants receiving this type of nitrogen. The plots receiving 28 lbs. of nitrogen as urea were easily the darkest in the field, whilst the single urea plots were darker than those which had received two doses of fishmeal. A count of the number of leaves emerged, flower stage and height taken eight weeks after planting out showed that lack of nitrogen led to delayed flowering and considerably

stunted growth. No effect upon the leaf number was apparent. No differences in these factors occurred between the one and the two dose series at this time.

The most obvious effect of the omission of nitrogen from the fertiliser was a more or less dwarfed condition of the plants accompanied by small leaves of a very light yellowish colour as soon as sufficient time had elapsed to make the nitrogen starvation apparent. The plants receiving no nitrogen were shorter and produced smaller thinner leaves than those obtaining a supply of this element. The leaves too assumed an upright habit due to their shortness. When, however, later in the season they become heavier the normal drooping appearance was presented. This was true, but to a lesser degree with the 1 and 2 dose series, except that in this case the leaves bent over more quickly.

It appeared in the field that the plants receiving no nitrogen were ripening first, followed, generally speaking, by the single nitrogen series and then the double nitrogen series. Owing, however, to the very light colour of the leaves in the first named series and to the fact that a great deal of false ripeness occurred the date of the first picking was somewhat difficult. From green weight figures obtained at the various pickings no differences between the no nitrogen plots and those receiving one dose were found, although both series were earlier than plots which had received 28 lbs. nitrogen per acre. It was noticeable that the single urea plots showed up well for early ripening.

Generally speaking, the two dose series were the slowest to mature, but the "peak" period in which the greatest weight of leaf was harvested occurred at the same picking for all the plots.

General Conclusions.—The results of all treatments were most carefully analysed and were finally judged by the yield per acre and price per lb. The type of material from which the tobacco plant derives its organic nitrogen is of far less importance than the amount of nitrogen added. Lack of nitrogen leads to dwarfed plants in the field and thin, short, bright but "rubbishy" leaves on the grading table. Moreover, these leaves are harsh to the touch and lack the lustre of those

receiving nitrogen. Contrary, too, to what might be expected the amount of brights is not in any way increased by lack of this element.

The addition of the first 14 lbs. of nitrogen to a fertiliser lacking this element leads to the enormous increase in gross returns of nearly £12 per acre for an extra expenditure of roughly 10s. An increase of twice the nitrogen over that ordinarily used, *i.e.*, from 14 to 28 lbs. per acre, leads to increased yields (the increase being much smaller than that given by the first 14 lbs.), a darker type of leaf and a reduction in price per pound. The gross value per acre is, in spite of this fact, a little higher than that given by the single dose of nitrogen.

In the single dressing there is little to choose between the various "organics," but at 28 pounds of nitrogen per acre urea and cyanamide show up better than bloodmeal and fishmeal, which give values, if anything, somewhat lower than those yielded at the single dressing.

The overall effect of lime at 5 cwts. per acre is negligible, both as regards yield, quality and gross value. But if the individual fertilisers are examined it is seen that there is an increase in value both at the single and double dressings of nitrogen if lime be present, except in the case of cyanamide, which yields decreased values with lime. These figures are not proved conclusively, since they may have arisen by chance; but the general fact should be borne in mind for future work.

It is sometimes stated that lime has an injurious effect upon the colour of the tobacco. At the rate applied in this experiment no such effect was noticed, the proportion of "brights" over the whole experiment being the same with or without this mineral. Those plots receiving two doses of nitrogen and those receiving none also showed no difference in the percentage of "brights" obtained. In the case of a single dose, however, lime produced a slight increase in "brights" in the case of cyanamide and bloodmeal and a decrease with urea and fishmeal. But, these differences are without effect upon the gross returns per acre.

On this year's results both urea and cyanamide seem suppliers of organic nitrogen of promise, the former especially because of its quick availability and its only slightly acid reaction in the soil. As a double dressing with lime urea has yielded the greatest returns per acre. Both urea and cyanamide are considerably cheaper per unit of nitrogen than bloodmeal.

The H.O.P. fishmeal was "balanced up" before being used, but as a form of fertiliser by itself it is doubtful if it could compete with the other mixtures used.

In conclusion, it must be remembered that these "organics" supplied only one-third of the total nitrogen in the fertiliser. Urea and cyanamide should be tested against bloodmeal with different proportions of a supplier of inorganic nitrogen. Possibly the results obtained this year may be enhanced if a large proportion of these "organics" were included in the fertiliser.

Samples of all the treatments have been saved for chemical analysis and smoking tests.

Note.—Cyanamide is not actually of organic origin, whereas fishmeal, bloodmeal, and urea are true organic substances. For the purposes of this experiment, however, cyanamide has been classified as "organic," since in conformity with the other three substances it supplied one-third of the total nitrogen in the fertiliser.

NEMATODE INVESTIGATIONS.

Root eelworm, root knotworm, or nematode, scientifically known as *Heterodera marioni*, constitutes one of the gravest dangers to tobacco growing in Southern Rhodesia. During the last few years a number of problems regarding this pest have presented themselves to tobacco growers. There have been suggestions made that in some localities at least this nematode appears to occur in indigenous plants in virgin veld. Old native lands have been suspected as the source of infestation, and storm water washing over such lands the means of carrying the pest to new lands or to the streams. In order to obtain reliable information on tobacco nematode the Tobacco Research Board seconded Mr. J. C. Collins, B.Sc., Lay

Assistant at Trelawney, to spend his whole time on this problem from November, 1935. The following notes are extracts from Mr. Collins' report on the last season's work.

1. **Westcote.—Survey of Degree of Infestation.**—To avoid the introduction of *H. marioni* to this station four acres of heavily infested land were leased from Mr. Biljon at Westcote, a distance of eight miles from the station.

The original idea was that if this land proved suitable, experiments should be carried out on it in future seasons, and with this end in view a survey of the degree of infestation of the whole land was made in respect to its different parts, to act as a standard of comparison for future treatments.

The four acres in question were divided into sixteen blocks of ¼ acre each and planted with apparently clean plants of White Stem Orinoco grown in the seedbeds of the Tobacco Research Station. These seedlings had received exactly the same treatment as all other beds. Planting operations were carried out on 10th and 11th January respectively, and of 16 plants selected at random (one from each plot) on 20th January, seven showed signs of nematode infestation, thus showing that the eelworm commence attacking the tobacco almost immediately it is planted in the lands. On 20th January it was found necessary to re-plant entirely 2½ acres owing to losses occasioned by cutworms, wireworms, crickets and unfavourable weather conditions. Of the remaining 1½ acres it was only necessary to re-fill about 10 per cent. of the plants.

During the growing season plants were pulled up at random from time to time and infection counts made. Counts made on February 13th and 20th showed an average infection of 76.25 per cent. over the entire four acres. The minimum infection being 20 per cent. in plot No. 9 and the maximum 100 per cent. in plots 12 and 16 inclusive. The next count was made on 24th April and the average infection over the entire block of 16 plots was calculated to be 98.56 per cent.—ranging from 91 per cent. to 100 per cent. On May 1st the final count showed the average infection to have reached 99.68 per cent., the minimum infection being 98.3 per cent. in plot No. 3.

In addition to ascertaining the number of plants attacked per plot attention was paid to the intensity of infestation relative to the particular plant. In order to do this some definite system of classification had to be adopted, and owing to the number of my visits to Westcote being severely restricted and my time for nematode work limited, it was essential that the system be both simple and rapid.

The following method seemed to satisfy conditions and requirements. The attacked plants were divided into three groups. Under Group 1, or the heading "Slightly Attacked," were included plants which were attacked but on which it was difficult at a first glance of the naked eye in the field to see the galls even when the plants were held in the hand. Group II., "Severely Attacked," contains plants on which the galls were easily discernible when the plants were held in the hand; while Group III., "Very Severely Attacked," were included those plants on which the galls were obviously apparent even while the plants were lying flat on the ground and the observer standing erect.

It was found, as might readily be expected, that the intensity of the infestation with reference to the plant steadily increases as the season progresses. In other words, in February the vast majority of the plants fell in the category of "Slightly Attacked," while on the 24th April and 1st May the majority were included in Group III., "Very Severely Attacked." The reason for this is not difficult to determine: as the rainy season progressed the conditions became more favourable for nematode activity and reproduction so that fresh galls were formed and old ones increased in size and coalesced. The increased nematode activity was confirmed by miscroscopic examination of the galls on the roots from time to time.

The final count having been made the remaining plants were uprooted, removed from the land and stacked to dry preparatory to burning.

At the close of the season it was decided by the Tobacco Research Board that Westcote was too far removed from the Tobacco Research Station to allow of constant supervision of the plots and accordingly nematode infested land was sought nearer.

2. **Roxburgh.—Survey of Degree of Infestation.**—Approximately $11\frac{1}{2}$ acres of nematode infested land has been very kindly provided by O. C. Rawson, Esq., on the Roxburgh Section of the Darwendale Estates. After the Estates had reaped all the leaf they wanted from the land a survey of the degree of infestation was carried out.

The land was divided into plots of approximately one-sixteenth of an acre each ($17\frac{1}{2}$ yards x $17\frac{1}{2}$ yards) and 20 per cent. of the plants in each plot were selected at random to serve as a sample for determining the degree of infestation.

The infestation varied from 100 per cent. to 10 per cent.

The field in question has a pronounced slope from east to west and from north to south, and there is a low-lying area in the centre. Popular opinion would therefore expect this low-lying area to be the most severely infested. Actually, however, the reverse is the case, the most heavily infested area being the most elevated. It is difficult to account for this state of affairs, as a deep open drain protects the land on the eastern edge from fresh infection being washed on to it, and on the north side, until the winter of 1935, the surrounding land was ordinary dense virgin bush veld. Last year, however, this area was stumped and planted to Virginia tobacco—a road about 9 feet wide now separating the two lands. As a result of general observations nematode infestation was apparent only along the eastern edge of this land, which coincides with the eastern edge of the land under experiment. A few individual plants in the centre of the field also showed signs of attack.

I understand from Mr. Collins, Manager of the Darwendale Estates, that to the best of his knowledge both these lands in question were at no time under native cultivation, so that if this information be correct it would be reasonable to infer that either (1) nematode were already present in the soil and living on the native weeds when the land was stumped, or (2) nematode was introduced from the seedbeds. In this connection tobacco volunteers in the seedbeds on Roxburgh were carefully dug up and examined, but showed no signs of galls. There is a slight possibility, however, that the Section-Manager of Roxburgh made use of seedlings from another farm neighbouring Roxburgh, where I know eelworm to have

been active in the seedbeds. Endeavours have been made to determine whether this exchange of seedlings had taken place or not, but unfortunately no one is in the position to confirm this supposition.

The land under experiment was cropped for the first time with Virginia tobacco during the season 1934-35. Prior to that it was natural bush veld. During the season 1935-36 it was again put down to Virginia tobacco.

3. **Determination of Native Host Plants.**—A survey of weeds and grasses in and around the land under experiment at Westcote and Roxburgh was carried out, also of those growing on the banks of the River Squatodzi in the neighbourhood of the two blocks of seedbeds belonging to Roxburgh. The following is a list of plants on which galls were observed.*

Aerva leucura, Moq.
Amarantus graecizans, L.
Amarantus viridis, L.
Aeschynomene minutiflora, Taub.
Cleome monophylla, L.
Conyza aegyptiaca, Ait.
Gynura cernua, Benth.
Hibiscus canabinus, L.
Senecio, sp.
Vernonia glabra, Vatke.

Of the several plants examined miscroscopically it was found that in each case the galls were the result of the activity of *H. marioni*. Unfortunately, time and opportunity did not permit of all the above plants being thoroughly examined. It is intended that this line of work be repeated in greater detail during the coming season.

The following is a list† of plants occurring in the same localities as the above but showing no signs of nematode attack.

Helichrysum argyrosphaerum, D.C.
Berkheya gracilis, O. Hoffm.

*The plants were determined by Dr. Brain, to whom due acknowledgement is made.

†Twelve other plants, so far not identified owing to being imperfect specimens

Bidens pilosa, L. (Black Jack).
Coreopsis insecta, S. Moore.
Conyza sp.
Diplolophium zambesianum, Hiern.
Englerastrum Schweinfurthii, Briq.
Erlangea laxa, S. Moore.
Eriocaulon sp.
Helichrysum sp.
Helichrysum sp.
Helichrysum pachyrhizom, Harv.
Indigofera sp.
Indigofera sp.
Leucas martinicensis, R. Br.
Orthosiphon bracteosus, Bak.
Oxalis sp.
Polycarpaea corymbosa, Sam.
Polygonum tomentosum, Willd.
Pseudarthria Hookeri, Wight & Arn.
Ricinis communis, L.
Sida rhombifolia, L.
Solanum sp.
Tagetes minuta, L.
Triumfetta sp.
Veronia leptolepis.
Waltheria americana, L.
Wormskioldia longipedunculata, Mast.

4. **Examination of River Water.**—Many experienced tobacco growers in this country are convinced that root-knot nematode is introduced to seedbeds with water from certain streams, and as this is quite a moot point a comprehensive series of experiments by means of pot cultures is at present being carried out to determine whether this is the case or not.

Fifteen tins were sterilised, filled with sterilised soil obtained from a clean field on the Tobacco Research Station and divided into five series of three tins or "pots" each. Nine clean tobacco seedlings grown from seed in sterilised soil and watered with boiled water were planted in each tin.

The experiment was started on 15th May, and as there is no hot-house on the Research Station, it was attempted to grow the plants in a passage of the curing chambers. Each series

was placed separately on stands in such a way as to permit a maximum of light reaching the plants and at the same time rendering it impossible for water escaping from one series coming into contact with the tins of another. The temperature was controlled by passing steam into the curing chambers themselves, the doors between the chambers and the passage (where the pot cultures were placed) remaining closed.

Series I. was watered with clear running water obtained from the River Squatodzi and from the exact localities from which the Roxburgh seedbeds were watered.

Series II. was watered with a mud suspension of Squatodzi water obtained from the same localities as the above. This mud suspension was made to resemble as nearly as possible the type of suspension or sludge which is used in seasons when the river is very low or when boys allow their buckets to scrape up mud from the banks of the river.

Series III. was watered from a borehole on the Tobacco Research Station, and Series IV., the control, with boiled water. A fifth series was introduced and received water that was known to be infested so as to keep a check on nematode activity. Fresh supplies of water were obtained every two days, thus obviating storing large quantities in the tanks which might conceivably have effected to a certain extent the survival of any *H. marioni* the water might contain.

On 27th May examination of three plants from each series gave negative results for Series I., III., IV. and V., but in Series II. one female of *H. marioni* was observed.

Unfortunately at about this time the boiler had to undergo repairs and the resulting fall in temperature from not being able to use it, retarded nematode activity and impeded plant growth to such an extent that on the 14th June it was found necessary to discard all plants.

Since that date no less than eight attempts have been made to germinate tobacco seedlings in order to repeat the experiment, but owing to unfavourable temperature conditions it is only now that success is being met with in this direction.

Miscellaneous.—(1) Determination of longevity of H. marioni.

(*a*) *In air dried soil.*—Under laboratory conditions four and a half months (20/5/36 to 5/10/36) have elapsed and *H. marioni* are still surviving.

(*b*) *In waterlogged soil.*—Few eelworm survive, but 60 days of continuous flooding have been found insufficient to destroy all stages.

(*c*) *In clear river water.*—Under laboratory conditions few *H. marioni* appear to survive over six days, but specimens have been found to be alive on the 11th and 13th days. Eggs do not appear to be affected.

(2) Treatment of water to destroy H. marioni.—Possibilities of this as a means of control are receiving attention.

1936-37 PROGRAMME OF WORK.

The following outlines give the programme of work planned for the present season as approved by the Tobacco Research Board:—

Cultural Investigations (H. F. Ellis in charge).

A.—*Spacing Trials.*

1. A large scale experiment comprising twenty-four treatments. Two levels of double complete fertiliser at 200 and 300 lbs. per acre. Three varieties to be tested, *viz.*, White Stem Orinoco, Jamaica Wrapper, Willow Leaf. Four spacings to be used, *viz.*, 4 ft. x 2 ft., 3 ft. by 2 ft., 3 ft. by 2 ft. 6 ins., and 3 ft. 6 ins. by 2 ft. 6 ins.

2. Testing nine different spacings, the best of those tried last year, the tobacco in each spacing receiving the same fertiliser dressing per acre, irrespective of the total number of plants.

3. A series including each of the above spacings where each plant receives exactly the same amount of fertiliser. By this means it is hoped to test the exact effect of spacing on yield and quality.

B.—*Topping Trials.*

One level of fertiliser used throughout for three different varieties, *viz.*, White Stem Orinoco, Willow Leaf and Jamaica Wrapper. Two heights and three stages of topping to be tested.

C.—*Rotation Trials.*

1. Continuation of three-year rotation trials previously laid down.

2. Tobacco to be planted after a large number of different crops sown last year to test their effects on the yield and quality of the subsequent tobacco. A number of the crops, such as perennial grasses, are being grown on for a second and third year.

D.—*Phosphate Trials.*

Continuation of the series laid down for the past three years.

E.—*Time and Method of Application of Fertiliser.*

A combination of two of last year's experiments testing three different methods of three different times of application of fertiliser.

F.—*Priming Trials.*

A new series laid down to test the effect of different methods, heights and time of priming on disease control and the yield and quality of the cured leaf.

G.—*Curing Investigations.*

Testing of curing chambers, relation between curing and outside temperature and humidity, optimum conditions for different varieties, possible beginning in conjunction with the Chemist the study of changes taking place in the leaf during the curing.

Plant Breeding Investivations (Dr. A. A. Moffett in charge).

A.—*Selection within Varieties.*—Several single plant selections have been made within each of the seven varieties totalling in all thirty-six selections. These selections have been based on general habit of the plant, leaf shape, and quality of the cured leaf. Plots of these selections are being duplicated, one plot being grown on new land and one on second year land.

The following are the varieties and the number of selections made in each. (S.P.S. indicates a single plant selection).

White Stem Orinoco, Strain 1	4 selections.
White Stem Orinoco, Strain 2	5 ,,
Jamaica Wrapper, S.P.S. 1...	6 ,,
Jamaica Wrapper, S.P.S. 2...	2 ,,
Jamaica Wrapper (smallest ruffle selection)...	2 ,,
Cash, S.P.S. 1	1 ,,
Bonanza, Canada, S.P.S. 1	3 ,,
Willow Leaf, S.P.S. 1...	2 ,,
Cokers Gold Dollar, S.P.S. 1	2 ,,
Cokers Gold Dollar, S.P.S. 2	3 ,,
Yellow Mammoth, S.P.S. 1	3 ,,
Yellow Mammoth, S.P.S. 2	1 ,,

B.—*Varieties not as promising as those under A.*—A mass selection has been made from each of the following varieties and a single plot will be grown of each for further observation:—

Bonanza, U.S.A.	Virginia Bright, U.S.A.
Jamaica, U.S.A.	Meadow Giant.
Moss Special, U.S.A.	Ambalema.
Narrow Leaf Orinoco, Mauritius.	Vumba.

C.—*Nicotine Content.*—Highest nicotine selection.—One plot from the plants which give the highest nicotine analysis.

Lowest nicotine selection.—One plot from the plant which gave the lowest nicotine analysis.

D.—*Crosses between Varieties.*—Seven plots comprising the first generation of crosses made last year between promising varieties are being grown.

E.—*Varieties Imported by Dr. Nierenstein.*—Twenty-four plots of varieties obtained by Dr. Nierenstein from the United States and Canada. Also eight plots of the varieties from U.S.A. which have been grown in Nyasaland for one year already.

F.—*Variety Trials.*—Seven varieties are being tested out in a variety trial. This trial is being laid down on both first and second year land to test out the varieties on both types

of soil and to obtain as much information as possible as to the relative merits of the varieties concerned. The lay-out in each case is a Latin square of standard type giving seven replications of each variety.

The following varieties are being tested:—

White Stem Orinoco, Strain 1.	Jamaica Wrapper.
White Stem Orinoco, Strain 2.	Coker's Gold Dollar.
Willow Leaf.	Yellow Mammoth (Canada).
Bonanza (Canada).	

G.—*Mosaic Resistance.*—Breeding work on resistance to mosaic disease is being combined with an experiment to test the resistance to mosaic of White Stem Orinoco and Jamaica Wrapper and crosses between these varieties and Ambalema (a mosaic resistant type). This experiment is also being utilised to try to obtain a resistant strain from White Stem Orinoco or Jamaica Wrapper by inoculating a large number of plants with mosaic and breeding from those which appear to be less susceptible or show resistance. Dr. Wickens is co-operating in this experiment as regards methods of inoculating the plants and of recording the degree of infection.

Tobacco Plant Physiology (Mr. H. C. Thorpe in charge).

1. *Lysimeter Trials.*—Owing to the very unsatisfactory nature of the lysimeters used last year it is felt that these trials should be left temporarily in abeyance until such time as a suitable apparatus can be devised or large-scale lysimeters built.

2. *Tablet Fertilisation.*—To be continued for another year as it is felt unwise to base any conclusions upon tests carried out at the extreme end of the growing season. The tablets have been manufactured considerably larger so that the use of one tablet per hole will supply four pounds of nitrogen per acre or one-third of the total given.

3. *Coloured Seedbed Cloth Experiment.*—To be continued for another year.

4. *Sources of Nitrogen and their Interaction with Lime.*—To be continued for another year.

5. *Urase Experiment.*—Urase to be included in the fertiliser mixture as (say) powdered soya bean. May possibly even up the availability of nitrogen during the season.

6. *Measurable Characteristics.*—Weekly measurements. (1) Height of plant, (2) number of leaves produced, (3) width of leaves (4) length of leaves and (5) internodal distances to be determined on a selected number of plants throughout their life under a standard manurial dressing. The idea underlying this is to test the constancy of the above characteristics and to determine the variability both within and between plants and also seasons with a view to ascertaining their value for plant characterisation.

7. *Leaf Characters.*—Weight of leaf per unit area as a measure of thickness. How many samples are required to characterise any leaf with a given accuracy? Variability of thickness within and between plants. May possibly be extended to cover manurial differences. Possible relationship between thickness of green leaf and some property of the cured product.

8. *Chemical Analysis.*—Should be done on samples of promise—protein, nicotine, and carbohydrates "bad" smoke said to be alkaline, so interest may attach to the protein nicotine and C:N ratios. Samples of leaf could be burnt in an excess of air and the products collected in standard acid. Relative alkalinities could be found and some relationship be tried with the original treatment.

9. *Effect of Three Levels of Phosphorus, Nitrogen and Potassium and the Interaction between them.*—This experiment is being conducted as a large-scale field trial covering in all twenty-seven treatments.

10. *Effect of Minor Elements.*—Owing to the extremely concentrated nature of the fertilisers used in this country it is felt that possibly there may be lacking some elements essential to the proper growth of the tobacco plant. Even if such deficiencies are not so acute as to cause definite systems of disease, an improvement in quality and growth may be affected by the addition of very small quantities of the limiting element. This hypothesis is being subject to experiment.

11. *Chlorine Tests.*—The effect upon the growth of tobacco upon the quantity of the cured leaf by the addition of varying amounts of chlorine, both as muriate of potash and in other forms, is being investigated. The effect of chlorine upon the leaf may be judged by a comparison with plots, included in the series, receiving none of this element.

12. *Ratio of Organic to Inorganic Nitrogen.*—A series of plots are to be laid down to test the effect of varying the proportion of organic to inorganic nitrogen. At one end of the scale all nitrogen is to be derived from "organic" sources, whilst at the other end only "inorganic" materials will be used for the supply of nitrogen. In between various proportions of organic nitrogen will be tried out. In addition some chosen mixture will be included for purposes of comparison.

13. *Miscellaneous Plots.*—A limited number of plots will be laid down to test the effect of increasing quantities of lime and of increased fertiliser applications upon tobacco, both in the field and as cured leaf. A few plots will be included on third-year land with a view to seeing whether by decreasing either the quantity of fertiliser applied or by decreasing the amounts of the individual fertiliser ingredients any improvement in quality or growth may be effected.

Nematode Projects (Mr. J. C. Collins in charge).

1. Examination of river water for presence of *H. marioni* by means of pot cultures and centrifuge.

2. Treatment of infested water by means of (*a*) sand filters and (*b*) chemicals.

I have sufficient evidence to warrant suspecting water from certain localities in certain rivers to be infested.

3. Treatment of seedbeds with chemicals.

Field Experiments.

4. Six three-year rotations.

5. Four four-year rotations.

6. Three five-year rotations.

7. Trap crops *versus* heavy applications of fertiliser *versus* sodium cyanide.

8. Cultural practices, including hoeing at frequent intervals and intermittent hoeing and ploughing.

9. Observation Plots.—A large number of agricultural crops are being tried out to determine whether or not they are susceptible to the attack of *H. marioni* with a view of using the more suitable in future seasons in rotations and as trap crops.

10. Determination of native weed hosts.

Plant Pathology (Dr. G. M. Wickens in charge).

Main Investigations.—1. Spraying and dusting the seedbeds with various copper fungicides, to assess their relative practical value in :—

(*a*) reducing leaf-spot diseases;

(*b*) capacity for adhering to the leaf surfaces during watering and rain.

(*c*) ease, speed and cost of application.

2. Spraying and dusting in the lands with a wide range of copper fungicides, to estimate the practical value of field spraying and to find a substitute for Bordeaux Mixture without the serious practical disadvantages of the latter. In these field experiments the influence of height of priming on the incidence of leaf-spot diseases will also be studied.

3. Investigation of the possibility of mosaic being carried in the soil, either retained in the soil or carried by remnants of plant roots, in such a way that replants in hills from which mosaic plants have been rogued may themselves become infected. If this source of infection be found to occur, then the duration of the soil infection will be studied.

4. In co-operation with Dr. Moffett, a study of the degrees of resistance of a believed-to-be-resistant variety, susceptible varieties, and crosses between them.

Other investigations.—(To be carried out as far as time and opportunities permit, in co-operation with Tobacco Research Officer and Tobacco Physiologist).

5. The influence of different levels of nitrogenous, phosphatic and potassic fertilisers on the development of naturally occuring diseases.

6. The influence of times and heights of topping on the development of red rust.

7. The influence of the addition of salts of the minor elements to the soil on the development of deficiency diseases, if it should occur.

8. The host range of tobacco mosaic virus, paying particular attention to common weed and garden plants.

9. The potentiality of cigarettes, tobaccos and snuff as carriers of tobacco mosaic virus and as sources of infection in the lands.

10. Search for substance, cheap, easily prepared and innocuous to the skin, that will rapidly inactivate tobacco mosaic virus in the gum retained on the hands after handling an infected plant.

FIRE-CURED TOBACCO INVESTIGATIONS.

The production of fire-cured tobacco is concentrated mainly in the Mazoe Valley, with Shamva as the main centre. During 1935 the fire-cured tobacco growers formed an association and appointed a committee, with Capt. J. M. Moubray, of Chipoli, as Chairman. This committee drew up a scheme for research and applied to the Government for a sum of £600 to enable the work to be carried out. It was proposed that this work should be done by Mr. C. E. Strickland on his farm Lion's Den, at Shamva, and that on the understanding that he would grow no other tobacco he should be paid £400 per annum for his trouble, for the use of his barns, etc. The remaining £200 of the £600 asked for was for native labour, fertiliser, seedbed cloth, hessian, etc. The Government agreed to the provision provided it was on the Estimates of the Tobacco Research Board and was supervised by the Board.

Fire-cured Tobacco Investigations 1935-36.—The investigations carried out during the past season were:—

(*a*) Fertiliser trials, chiefly concerning nitrogen and potash;

(*b*) Spacing trials, with the varieties Western and Little Crittenden.

(*c*) Variety trials.

Mr. Strickland's report on the season's work was published in the November *Journal.*

Programme for 1936-37 Season.—The Committee of the Fire-cured Tobacco Growers' Association discussed future work with Dr. Nierenstein during his visit and it was decided to simplify the programme by restricting the investigations to a few well known varieties and by having fewer and larger experimental plots. The fertiliser and spacing trials are being repeated.

Finances.—The amount provided on the Estimates for the year ending March 31st, 1936 was £5,444.

In terms of the Tobacco Research Act the Government provides £5,000 annually for tobacco research, plus pound for pound of any excess of this amount expended. The remainder is provided from the Tobacco Research Trust Fund.

The contribution from this fund for the season 1935-36 was therefore estimated at £444, but the actual amount was £212 4s. 1d. The estimates for 1936-37 provided £5,756, and it is therefore estimated that the Trust Fund will be called upon to provide £756.

Trust Fund.—In terms of the Tobacco Research Act, 1935, all donations received by the Tobacco Research Board towards the expenses of tobacco research are paid into the Trust Fund, which is vested in two trustees, *viz.*, The Minister of Agriculture and Lands and the Chairman of the Board.

During 1935 the amount paid into the Trust Fund was £605, and during 1936 £1,168 5s. 0d. Withdrawals to date amount to £212 4s. 1d.

It will be noticed that very little call has yet been made on the Trust Fund, but it will be obvious from the foregoing report that the tobacco research work is only in its initial stages. The Tobacco Research Board has been careful not to estimate for any expenditure which could not be amply justified, nor to provide for any investigations until they were satisfied that such work had been carefully considered and accurately planned. The scope of the work has, however, been considerably increased during the last six months, and it is plainly indicated that further extensions will become essential

as the work progresses. As an example of a line of action which will soon be necessary it may be mentioned that the Tobacco Research Board has recently considered a number of requests from tobacco growers for an advisory service from the Trelawney Station, based upon the experience gained on that Station. It was definitely laid down at the outset, however, that the Board would not allow any routine or advisory duties to interfere with the research work of the technical staff of the Research Station, and it has therefore been necessary to consider ways in which the results of experiments carried out there could be most expeditiously made known to the tobacco growers, and this matter is at present receiving the careful consideration of the Board.

Acknowledgements.—The Tobacco Research Board records its appreciation and thanks to the following contributors to the Trust Fund for their generous support:—Messrs. Imperial Tobacco Company, Ltd., Rhodesia Tobacco Association, United Tobacco Company (South) Ltd., Frank Watson & Co., Ltd., Jul Siemssen & Co., MacMillan Maxwell & Co., and P. L. Levasson, Esq.

Southern Rhodesia Weather Bureau.

MARCH, 1937.

Rainfall.—The rainfall for the month was about 2 inches below normal, making the total for the season half an inch below normal.

Weather Features.—During the first few days of the month a tropical cyclone was traversing the east coast of Madagascar from north to south. The cyclone induced a south-easterly current over Southern Rhodesia, and unsettled weather was associated with the onset of the current on 1st and 2nd. The south-east current was replaced by a westerly current on the 5th, the centre of the cyclone being then some distance to the east of the southern extremity of Madagascar. Weather was fair from the 3rd to the 6th, but a southerly high caused moderate south-east winds from the 7th to the 9th, and rain or drizzle was recorded fairly generally, but falls were mostly light. The high remained stationary over South Africa up to the 12th, and fair weather prevailed.

A deep low developed over the south coast of the Union on the 12th and moved to the south-east coast on the 13th. On this day a tropical cyclone appeared near the north-east coast of Madagascar. It subsequently crossed into the Mozambique Channel, and although it soon lost its violence, it continued as a low over the Channel until the 21st, when it recrossed Madagascar and moved off in a south-south-easterly direction. Showers occurred from the 13th to the 16th, mainly in the north of the country, and thereafter fair weather continued until the 22nd. On the 23rd winds swung to the north, gradients were weak, and thunder conditions resulted.

A southerly high appeared over the south coast on the 25th, but was closely followed by a series of southerly lows, and weather remained unsettled until the end of the month, but heavy falls of rain were confined to a few stations.

MARCH 1937.

Station.	Pressure Millibars, 8.30 a.m.		Temperature in Stevenson Screen °F.								Rel. Hum.	Dew Point	Cloud Amt.	Precipitation.			Altitude (Feet)
			Absolute.		Mean.												
	Mean.	Normal.	Max.	Min.	Max.	Min.	½ Max. Min.	Normal.	Dry Bulb.	Wet Bulb.	%	F.	0-10	Ins.	Normal	No. of Days	
Angus Ranch... ...	...	...	91	59	82.7	64.9	73.8	75.1	73.4	67.4	73	64	...	2.15	4.15	4	...
Beitbridge...	962.8	...	100	58	89.4	67.6	78.5	...	75.5	68.6	71	65	5.9	0.95	1.58	5	1,500
Bindura...	890.4	...	89	54	82.8	62.8	72.8	...	70.9	64.9	73	62	3.6	2.01	4.95	8	3,700
Bulawayo	868.9	869.4	86	48	79.5	57.6	68.5	68.7	67.1	62.4	59	59	6.4	2.04	3.31	8	4,393
Chipinga	891.6	...	85	54	76.7	60.7	68.7	...	68.6	64.0	79	62	4.3	2.68	7.91	14	3,685
Enkeldoorn...	856.9	...	87	48	78.9	58.1	68.5	68.7	67.2	61.5	73	58	3.8	0.80	4.03	3	4,788
Fort Victoria	894.8	895.3	89	50	80.5	59.0	69.7	69.0	68.9	64.3	79	62	6.8	5.69	3.62	12	3,571
Gwaai Siding	903.0	...	93	45	88.5	58.8	73.6	...	71.3	64.9	71	62	2.3	0.79	3.39	5	3,278
Gwanda...	906.0	...	90	49	81.8	61.8	71.8	...	70.5	65.5	77	64	6.3	1.84	3.00	8	3,233
Gwelo	861.5	...	86	48	78.8	58.2	68.5	69.6	66.1	61.3	77	58	5.5	3.17	3.39	7	4,629
Hartley...	884.3	...	88	48	83.4	58.1	70.7	71.8	70.5	64.0	71	61	3.1	1.99	4.35	7	3,879
Inyanga...	835.9	...	84	44	76.3	54.0	65.2	...	66.8	59.7	66	55	3.4	2.47	5.44	13	5,503
Marandellas	836.8	...	82	49	76.6	57.2	66.9	...	65.7	60.0	72	56	4.1	2.29	5.89	9	5,453
Miami	877.8	...	85	56	80.1	60.8	70.5	...	68.5	64.8	82	63	4.9	3.02	4.77	9	4,090
Mount Darwin ...	906.4	...	90	52	84.5	62.4	73.5	..	72.6	67.0	75	64	4.7	2.95	3.65	6	3,179
Mount Nuza	801.2	...	72	44	66.1	52.7	59.4	..	58.9	56.3	87	54	7.1	5.64	9.80	15	6,668
Mtoko	876.2	...	87	51	81.9	62.0	72.0	...	70.1	64.3	73	61	3.7	1.91	3.64	7	4,141
New Year's Gift...	...	...	91	55	82.8	61.6	72.2	...	70.5	66.4	81	64	...	2.39	3.74	10	2,690
Nuanetsi	961.0	...	96	56	87.2	65.0	76.1	...	74.2	69.0	78	66	5.9	1.42	2.45	2	1,581
Plumtree	863.6	...	86	51	79.3	58.7	69.0	...	68.7	61.9	68	58	4.2	1.31	2.82	9	4,549
Que Que	880.9	...	89	50	83.5	59.6	71.6	...	70.2	63.8	71	60	3.7	0.68	3.89	5	3,999
Rusape	861.1	...	86	50	78.7	58.5	68.6	...	65.2	61.5	81	59	4.2	2.32	5.06	7	4,648
Salisbury	...	856.1	...	...	...	...	...	68.0	...	...	.	...	...	2.53	4.47	8	4,831
Shabani...	909.3	...	90	52	81.3	62.8	72.1	...	71.2	65.5	74	63	5.3	0.54	4.05	7	3,131
Sinoia	887.3	...	89	52	84.3	59.2	71.8	...	71.4	65.0	71	62	1.7	0.73	4.11	7	3,795
Sipolilo	884.0	...	85	54	80.1	61.1	70.6	...	71.7	65.2	71	63	3.5	4.02	4.04	9	3,876
Stapleford	841.0	...	79	46	72.6	53.8	63.2	...	64.1	60.6	82	58	4.5	4.43	11.23	13	5,304
Umtali...	891.7	892.7	89	51	82.8	61.2	72.0	70.6	70.8	65.5	76	63	4.4	2.12	5.23	8	3,672
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Rainfall in March, 1937, in Hundredths of an Inch. Telegraphic Reports.

ea	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total	N n
l	4	...	...	...	...	11	5	1	...	...	...	...	...	6	5	...	...	...	...	...	2	...	25	...	27	18	1	30	...	9	58	202	3
	37	20	4	...	...	...	...	64	...	...	...	...	...	3	...	...	...	...	...	...	...	...	6	2	4	123	1	2	10	39	14	329	6
	47	23	20	6	...	...	28	49	...	...	...	...	...	9	...	...	...	...	6	...	...	...	...	39	16	9	27	3	7	5	11	305	8
	21	1	...	...	...	...	1	13	...	...	...	...	1	33	5	...	...	...	...	...	...	...	...	20	34	60	...	1	...	17	...	207	5
	4	16	...	...	...	3	73	1	...	...	...	1	...	...	10	...	...	...	...	...	...	...	5	...	60	11	4	15	32	3	...	238	2
	2	...	...	...	...	...	18	2	...	...	...	...	2	19	6	...	...	...	...	...	...	...	9	3	50	23	13	...	52	...	2	201	4
	28	...	4	3	...	...	4	11	...	...	...	...	7	16	7	1	...	1	...	3	...	...	3	5	50	67	25	4	7	6	...	252	5
	22	...	...	...	...	7	45	9	...	...	...	...	8	12	12	11	4	..	...	...	...	...	...	...	4	27	6	...	...	...	...	167	5
	44	4	...	1	...	...	21	17	4	...	...	...	5	47	8	7	5	2	23	2	19	...	...	...	23	25	6	...	3	1	..	267	4
	60	...	20	3	...	...	23	...	...	...	...	...	...	57	73	...	...	...	...	...	...	...	...	...	...	1	...	1	5	...	...	243	3
n	21	6	2	1	..	3	21	14	1	...	...	...	2	17	9	1	1	...	3	1	3	...	7	3	33	40	6	9	14	9	13	240	4

Southern Rhodesia Veterinary Report.

FEBRUARY, 1937.

DISEASES.

No fresh outbreaks of scheduled diseases.

MELLEIN TEST.

Seven horses and 20 mules were tested upon entry with negative results.

IMPORTATIONS.

From the Union of South Africa.—Horses 6, mules 20.
From the United Kingdom. Horses 1.
From Portuguese East Africa.—Pigs 6.

EXPORTATIONS—MISCELLANEOUS.

To the United Kingdom.—Chilled beef quarters, 5,379; frozen boned beef quarters, 1,425; frozen beef quarters, 4,986; kidneys, 1,277 lbs.; tongues, 3,545 lbs.; livers, 16,684 lbs.; hearts, 4,183 lbs.; tails, 1,483 lbs.; skirts, 1,233 lbs.; shanks, 2,120 lbs.

Meat Products.—From Liebig's Factory: Corned beef, 161,644 lbs.; rolled beef, 72 lbs.; beef fat, 36,000 lbs.; bone-meal, 70,000 lbs.

G. C. Hooper Sharpe,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-37.

Monthly Report No. 52. March, 1937.

There have been no reports of locusts in any stage in the Colony during the month of March.

RUPERT W. JACK,
Chief Entomologist.

Departmental Bulletins.

The following Bulletins are available for distribution at 3d. per copy. Application should be made to the Editor, Department of Agriculture, Salisbury, and remittances must accompany orders.

N.B.—The date the article appeared in the Journal is indicated in abbreviated form before the number, e.g., 8/22, No. 429, means that Bulletin 429 appeared in the Journal for August, 1922.

AGRICULTURE AND CROPS.

7/25. No. 545. Artificial or Synthetic Farmyard Manure, by H. G. Mundy, Dip.Agric., F.L.S.

3/27. No. 630. The Storage of Seed Potatoes, by H. C. Arnold.

5/27. No. 643. Noxious Weeds in Southern Rhodesia, by F. Eyles, Botanist.

12/27. No. 663. The Use of Fertilisers and Manures in Southern Rhodesia, by A. D. Husband, A.I.C., Chief Chemist.

2/28. No. 672. Hay-making in Rhodesia, by H. G. Mundy, Dip.Agric., F.L.S.

2/28. No. 674. Top Dressing of Maize against Stalk Borer, by H. C. Arnold.

3/28. No. 681. The Sunflower (Helianthus Annuus) (Revised), by S. D. Timson, M.C., Dip.Agric.

6/28. No. 695. The Castor Oil Plant (Ricinus spp.), by S. D. Timson, M.C., Dip.Agric.

9/28. No. 705. Suggested Cropping Programmes for Farms on the Sand Veld, by D. E. McLoughlin, Assistant Agriculturist.

10/28. No. 710. Monthly Reminders for the Farming Year, by the Division of the Chief Agriculturist.

3/29. No. 727. Farmyard Manure, by A. P. Taylor, M.A., B.Sc., Agricultural Chemist.

3/29. No. 732. Two Common Diseases of Potato Tubers in Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.

7/29. No. 743. Sunn Hemp, by S. D. Timson, M.C., Dip.Agric.

9/29. No. 751. The Sweet Potato, by S. D. Timson, M.C., Dip.Agric. (Wye).

10/29. No. 758. Instructions for Taking Soil Samples. Issued by the Division of Chemistry.

1/30. No. 768. The Ground Nut (Arachis hypogaea), by S. D. Timson, M.C., Dip.Agric. (Wye).

3/30. No. 776. Regulations Governing the Export of Maize and Maize Meal through the Port of Beira.

11/30. No. 797. Green Manuring: An Essential Practice in Rhodesian Farming, by H. G. Mundy, Dip.Agric. (Wye), F.L.S., Chief Agriculturist.

1/31. No. 802. Witch Weed, by S. D. Timson, M.C., Inter.B.Sc. (Agric.) London., Dip.Agric (Wye), Assistant Agriculturist.

3/31. No. 815. New Strains of Oats for Southern Rhodesia, by H. C. Arnold, Manager, Agricultural Experiment Station, Salisbury.

4/31. No 816. Preliminary List of the more Common Grasses of Southern Rhodesia, by Sydney M. Stent, Botanist for Pasture Research.

5/31. No. 822. Re-stacking of Maize rejected for Export on account of Excessive Moisture.

9/31. No. 826. Some Poisonous Plants of Southern Rhodesia, by Sydney M. Stent, Senior Botanist.

10/31. No. 831. Revised Notes on Cotton Growing in Southern Rhodesia, by G. S. Cameron.

11/31. No. 836. The Potato, by S. D. Timson, M.C., Dip.Agric. (Wye).

12/31. No. 837. Veld Grass Silage: A Feature in Rhodesian Pasture Management, by H. G. Mundy, Dip.Agric. (Wye), F.L.S., Chief, Division of Plant Industry.

1/32. No. 841. Poisonous or Suspected Poisonous Plants of Southern Rhodesia: Tulip Poisoning of Cattle, by Sydney M. Stent, Senior Botanist, and D. A. Lawrence, B.V.Sc., Veterinary Research Officer.

6/32. No. 855. Pigeon-hole Method of Stacking Maize, by Division of Plant Industry.

8/32. No. 859. Twenty-one Years of Plant Introduction, by Major Mundy, Chief Division of Plant Industry.

2/33. No. 878. A.I.V. Silage: Memorandum prepared and circulated by Imperial Bureau of Animal Nutrition.

11/34. No. 936. Witchweed, by S. D. Timson, M.C. Dip.Agric. (Wye), Assistant Agriculturist.

10/35. No. 970. Rhodes Grass for the Southern Rhodesian Tobacco Grower, by African Explosives and Industries, Ltd.

11/35. No. 972. Notes on Witchweed, by S. D. Timson, M.C., Dip.Agric. (Wye), Assistant Agriculturist.

6/36. No. 992. Annual Report of the Agriculturist for the year 1935, by D. E. McLoughlin, Agriculturist.

7/36. No. 994. Some Notes on Cotton Growing, by J. E. Peat, Senior Plant Breeder, Cotton Station, Gatooma.

4/37. No. 1022. Smut Diseases of Wheat in Southern Rhodesia, by G. M. Wickens, B.Sc. Agric., Ph.D., D.I.C., Plant Pathologist, Tobacco Research Station, Trelawney.

REPORTS ON CROP EXPERIMENTS.

7/27. No. 649. Annual Report of Experiments, 1925-26, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Manager.

4/28. No. 683. Annual Report of Experiments, 1926-27, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Station Manager.

7/29. No. 745. Salisbury Agricultural Experiment Station Annual Report, 1927-28, by H. C. Arnold.

7/30. No. 789. Agricultural Experiment Station, Salisbury. Annual Report of Experiments, 1928-29, by H. C. Arnold.

9/31. No. 830. Salisbury Agricultural Experiment Station, Annual Report, 1929-30, by H. C. Arnold, Manager.
10/32. No. 864. Annual Report, 1930-31: Agricultural Experiment Station, by H. C. Arnold, Station Manager.
6/33. No. 895. Salisbury Agricultural Experiment Station Annual Report, 1931-32, by H. C. Arnold, Manager.
3/34. No. 914. Gwelo Municipal Demonstration Station: Final Report, 1933, by S. D. Timson, M.C., Dip.Agric. (Wye), Assistant Agriculturist.
9/35. No 965. Salisbury Agricultural Experiment Station Annual Report, 1933-34, by H. C. Arnold, Manager.

TOBACCO.

8/26. No. 605. Flue-curing Tobacco Barns, Bulking and Grading Sheds, by P. H. Haviland, B.Sc. (Eng.), Acting Government Irrigation Engineer.
9/26. No. 615. The Culture of Virginia Tobacco in Southern Rhodesia: Field Management, by D. D. Brown.
5/27. No. 641. The Handling, Grading and Baling of Cured Virginia Tobacco, by D. D. Brown.
5/27. No. 644. Tobacco Baling Boxes, by B. G. Gundry, Irrigation Branch.
9/27. No. 653. The Care of Tobacco Seed Beds, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad)
11/27. No. 661. Flue-curing Tobacco Barns, 12 ft. x 12 ft. x 16 ft., by B. G. Gundry.
1/28. No. 665. Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.
2/28. No. 671. Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.
12/28. No. 715. Turkish Tobacco Culture in Southern Rhodesia, by D. D. Brown, Chief Tobacco Expert.
3/29. No. 728. Suggested Crop Rotations for Tobacco Growers, by D. D. Brown, Chief Tobacco Expert.
4/29. No. 734. Common Faults in Curing Virginia Bright Tobacco, by D. D. Brown, Tobacco and Cotton Expert.
8/29. No. 748. Frog Eye Disease of Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
9/29. No. 753. Leaf Spotting of Tobacco caused by Mosaic, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
2/30. No. 771. Dark Fire-cured Tobacco: Field Operations, by D. D. Brown, Chief Tobacco Expert.
3/30. No. 774. Dark Fire-cured Tobacco: Harvesting and Curing, by D. D. Brown, Chief Tobacco Expert.
6/30. No. 784. Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.
3/31. No. 812. Selection of Tobacco Seed Plants, by H. F. Ellis, M.Sc., B.S. (Agric.), Tobacco Adviser.

11/31. No. 835. Tobacco Culture: Transplanting Operations, by D. D. Brown.
3/32. No. 846. Leaf Curl in Tobacco, by Dr. H. H. Storey.
3/36. No. 885. Tobacco Culture in Southern Rhodesia: The Harvesting and Curing of Virginia Tobacco, by D. D. Brown, Chief Tobacco Officer.
8/36. No. 996. The "Gundry" Tobacco Furnace, by B. G. Gundry, A.I.Mech.E.
12/36. No. 1009. Tobacco Research on the Trelawney Station 1935-36 Season.
4/37. No. 1025. Report of the Tobacco Research Board, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture and Chairman of the Tobacco Research Board.

LIVE STOCK.

1/27. No. 624. The Construction of Dipping Tanks for Cattle (Revised).
1/31. No. 801. Sheep Farming in the Melsetter District, by J. C. Kruger, Part-time Sheep Adviser in the Melsetter District.
10/32. No. 863. Piggeries, by B. G. Gundry, A.I.Mech.E.
12/32. No. 871. Some General Observations on the Feeding of Dairy Cows on a Mixed Stock Farm, by Dr. A. E. Romyn, Senior Animal Husbandry Officer.
1/33. No. 873. The Hand-rearing of Calves, by C. A. Murray, B.Sc. (Agric.), M.Sc.
4/33. No. 887. The Type of Chiller Steer required for Export, by A. E. Romyn, Senior Animal Husbandry Officer.
5/33. No 891 Fattening Bullocks for Export, by A. E. Romyn, Senior Animal Husbandry Officer.
9/33. No. 903. The Handling, Preparation and Chilling of Cattle for Export, by C. A. Murray, Lecturer in Animal Husbandry.
12/33. No. 907. The Blackhead Persian: Its Breeding and Management in Matabeleland, by C. A. Murray, M.Sc., Lecturer in in Animal Husbandry, Matopo Estate.
1/34. No. 909. Stall Fed Chillers for the Overseas Christmas Market, by C. A. Murray, M.Sc., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.
2/34. No. 912. Economical Winter Rations for Wintering Dairy Heifers, by C. A. Murray, M.Sc. (Agric), Lecturer in Animal Husbandry, Matopo School of Agriculture.
4/34. No. 916. Cowpea Hay in the Ration for Bacon Pigs, by C. A. Murray, M.Sc. (Agric.), Lecturer in Animal Husbandry, Matopo School of Agriculture and Experiment Station.
5/34. No. 919. Saltbush: A Winter Succulent for Sheep in Matabeleland, by D. G. Haylett, M.Sc., Ph.D., Director, Matopo School of Agriculture.
6/34. No. 924. Raising Dairy Calves on a Limited Amount of Whole Milk, by C. A. Murray, M.Sc., Agr., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.

1/35. No. 943. Cattle Improvement and a Cattle Breeding Policy in Southern Rhodesia: A Review of the General Position Chiefly as regards Ranching Cattle, by Dr. A. E. Romyn, Chief Animal Husbandry Officer.

1/35. No. 945. A Home-made Cow Stanchion, by Major R. R. Sharp, Whinburn, Redbank.

3/35. No. 946. Economical Rations for Wintering Dairy Cattle, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station.

5/35. No 952. Annual Report of the Chief Animal Husbandry Officer for the year ending 31st December, 1934, by A. E. Romyn, Chief Animal Husbandry Officer.

7/35. No. 959. The Selection of a Dairy Bull, by A. E. Romyn, Ph.D., Chief Animal Husbandry Officer.

4/36. No. 984. Report on the Curing of Rhodesian Hides, by Advisory Committee on Hides and Skins of the Imperial Institute.

4/36. No 985. Export of Frozen Porkers. Third Consignment to Smithfield. Division of Animal Husbandry.

5/36. No. 987. The Curing of Hides and Skins on the Farm, by The Division of Animal Husbandry.

5/36. No. 988. Preparing Cattle for Show, by The Animal Husbandry Division.

6/36. No. 989. The Supplementary Feeding of Mineral and Protein Supplements to Growing Cattle in Southern Rhodesia and its Relation to the Production of Beef Steers, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E. Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Southern Rhodesia; D. G. Haylett, Ph.D., Director, Rhodes Matopo Estate; F. Ericksen, Dip. Agric., Experimentalist.

10/36. No. 1001. The Raising of Bacon Pigs, by A. E. Romyn, Chief Animal Husbandry Officer, and C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate, with a Veterinary Section by D. A. Lawrence, Director of Veterinary Research.

9/36. No. 1000. Sheep Management on the Mixed Farm, by R. H. Fitt, Animal Husbandry Officer.

4/37. No. 1023. Cowpea Molasses Silage for Fattening Steers, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station; A. E. Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Salisbury; R. H. Fitt, Dipl. Agric., Animal Husbandry Officer, Department of Agriculture, Salisbury.

4/37. N. 1024. Comparative Feeding Value of Maize Meal and Nyouti (*Pennisetum Typhoides*) Meal for Fattening Steers, by C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E. Romyn, Chief Animal Husbandry Officer.

DAIRYING.

3/29. No. 730. Common Defects in Butter-making, by T. Hamilton, M.A., N.D.A., N.D.D., and J. R. Corry, B.Sc. (Agr.), Dairy Experts.

12/30. No. 799. The Objects of Ripening Cream for Butter-making, and a few Hints on Cream Production, by F. Lammas, Dairy Officer.

4/31. No. 818. Farm Butter-making. Issued by the Dairy Branch.

9/32. No. 862. Cream Cheese, by F. A. Lammas, Dairy Officer.

3/33. No. 880. Dairy Tests and Calculations, by F. A. Lammas, Dairy Officer.

5/34. No. 922. Dairy Building in Southern Rhodesia: A Small Farm Dairy, by G. B. Gundry, A.I.Mech.E.

7/34. No. 926. Dairy Buildings in Southern Rhodesia. Cow Byre—Type II., by B. G. Gundry, A.I.Mech.E.

12/34. No 937. Gouda or Sweet Milk Cheese, by F. Lammas, District Dairy Officer.

2/36. No. 977. Notes on the Feeding of Dairy Cows during the Summer Months, by A. E. Romyn, Chief Animal Husbandry Officer.

6/36. No. 990. Southern Rhodesia Milk Recording Scheme.

VETERINARY.

10/14. No. 191. Scab or Scabies in Sheep and Goats, by Rowland Williams, M.R.C.V.S.

4/25. No. 536. Inoculation of Cattle against Redwater and Gall Sickness, by Ll. E. W. Bevan, M.R.C.V.S.

12/25. No. 570. The Spaying of Bovines, by G. C. Hooper Sharpe, M.C., M.R.C.V.S., and M. H. Kingcombe, M.R.C.V.S.

6/26. No. 597. Suspected Poisoning of Stock: The Proper Procedure, by M. H. Kingcombe, M.R.C.V.S. (Lond.), and A. W. Facer, B.A. (Oxon.), A.I.C.

12/26. No. 618. Notes from the Veterinary Laboratory: Quarter Evil, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.

1/28. No. 666. Notes from the Veterinary Laboratory: Praemonitus—Praemunitus, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.

4/29. No. 739. The Laboratory Diagnosis of Animal Diseases: A Note to Emphasise some Points in the Preparation and Forwarding of Specimens, by D. A. Lawrence, B.V.Sc., Veterinary Research Officer.

10/29. No. 756. Parasitic Gastritis of Cattle, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.

11/29. No. 760. A Note on Sheep Diseases in Southern Rhodesia, by D. A. Lawrence, B.V.Sc., Veterinary Research Officer, Department of Agriculture, Salisbury.

2/30. No. 772. Notes from the Veterinary Laboratory: Ophthalmia, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.

4/31. No. 819. Measles in Swine, by P. D. Huston, M.R.C.V.S.

10/32. No. 866. The Treatment of Intestinal Parasites of Sheep, by J. D. Coutts, D.V.S., M.R.C.V.S.

4/33. No. 886. A Preliminary Note on Contagious Granular Vaginitis in Southern Rhodesia, by D. A. Lawrence, B.V.Sc., Acting Director Veterinary Research.

5/34. No. 921. Myiasis (Screw-Worm) in Cattle in Southern Rhodesia, by D. A. Lawrence, Director of Veterinary Research, and A. Cuthbertson, Entomologist.

IRRIGATION, WATER SUPPLIES AND SOIL EROSION.

3/27. No. 633. The Cost of Pumping for Irrigation, by R. H. Roberts, B.Sc. (Eng.).

4/27. No. 640. Levelling for Irrigation, by Dr. W. S. H. Cleghorn, M.I.Mech.E.

11/27. No. 659. The Hydraulic Ram, revised by P. H. Haviland, B.Sc.

11/28. No. 668. The Water Act, 1927, by C. L. Robertson, B.Sc. (Eng.), A.M.I.C.E.

1/28. No. 670. Irrigation Canals, by P. H. Haviland, B.Sc. (Eng.).

6/30. No. 786. Low Concrete Dams, by R. Hamilton Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

2/31. No. 808. The Application of Water in Irrigation, by R. Hamilton Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

3/31. No 811. Irrigation Canal Structures, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

8/32. No. 860. Soil Drainage and Utilisation of Vleis, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

2/33. No. 879. Conditions Governing the Hire of Government Boring Machines.

8/33. No. 900. Three Types of Water Tank, by R. H. Roberts, B.Sc. (Eng.), A.M.I.C.E., Assistant Irrigation Engineer.

6/34. No 923. Soil Eroison, by P. H. Haviland, B.Sc. (Eng.), A.M.I.C.E., Irrigation Engineer (Matabeleland).

6/35. No. 956. Annual Report of the Division of Irrigation for the year ended 31st December, 1934, by P. H. Haviland, B.Sc. (Eng.), Acting Chief Irrigation Engineer.

9/35. No. 964. The Use of Ditchers for Constructing Contour Ridges, by C. Tapson, Devondale, Concession.

9/35. No. 967. How to use an Engineer's or Farm Level, by P. H. Haviland, B.Sc. (Eng.), A.M.I.C.E., Irrigation Engineer (Matabeleland).

12/35. No. 973. Domestic Water Supplies and Sanitation on the Farm, by P. H. Haviland, B.Sc. (Eng.), A.M.I.C.E.. Irrigation Engineer (Matabeleland).

3/36. No. 980. Results from Glenara Soil Conservation Experiment Station, 1934-35 Season, by C. L. Robertson, B.Sc. A.M.I.C.E., Chief Engineer, Irrigation Division, and A. D. Husband, F.I.C., Chief Chemist.

8/36. No. 999. Lining an Irrigation Furrow, by R. H. Roberts, B.S.. A.M.Inst.C.E., Assistant Irrigation Engineer.

3/37. No. 1019. Soil Conservation, by D. Aylen, Esq., Outside Technical Assistant, and R. Hamilton Roberts, B.Sc., A.M.Iinst.C.E., Irrigation Engineer.

FORESTRY.

1/26. No. 575. Tending of Eucalyptus Plantations, by A. S. Thornewill, B.A.

11/29. No 763. The Utilisation of Wood, by T. L. Wilkinson, M.Sc., B.Sc.F.

1/30. No. 769. The Utilisation of Wood, by T. L. Wilkinson, M.Sc., B.Sc.F.

4/30. No. 778. The Utilisation of Wood in Southern Rhodesia—Conversion and Disposal of Timber, by T. L. Wilkinson, M.Sc., B.Sc.F., District Forest Officer.

8/30. No. 791. The Utilisation of Wood in Southern Rhodesia: Fencing, by T. L. Wilkinson, M.Sc., B.Sc.F., District Forest Officer.

2/31. No. 809. Establishing Pines: Preliminary Observations on the Effects of Soil Inoculation. Issued by the Division of Forestry.

4/31. No. 817. The Raising of Forest Seedlings and Transplants on the Farm, by E. J. Kelly Edwards, M.A., Dip.For. (Oxon.), Acting Chief Forest Officer.

7/32. No. 857. Charcoal Burning on the Farm, by R. J. Allen, Forester, Rhodes Matopo School of Agriculture and Experiment Station.

11/32. No 869. Wind-breaks and Shelter Belts, by A. A. Pardy, B.Sc., Forestry.

1/33. No. 874. Tree Planting, by the Division of Forestry.

4/33. No. 888. The Vegetable Ivory Palm (Hyphoene ventricosa), by G. M. McGregor, B.Sc., District Forest Officer, Matabeleland.

8/34. No. 927. Some Facts about Tung Oil, by R. H. Finlay, B.A., Dip. For. (Oxon.), District Forest Officer.

8/34. No. 928. Some Trees, Shrubs, Shrubby-Herbaceous Plants, Climbers and Water Plants suitable for the Colony, by J. W. Barnes, Manager, Government Forest Nursery, Salisbury.

12/35. No. 974. Summary of the Annual Report of the Division of Forestry for the year 1934, by E. J. Kelly-Edwards, M.A., Dip. For. (Oxon.), Chief Forest Officer.

Price List of Forest-tree Transplants, Ornamental Trees Shrubs, Hedge Plants, Creepers and Seeds obtainable at the Government Forest Nursery, Salisbury.

3/37. No. 1020. The Raising of Forest Seedlings and Transplants on the Farm, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.

HORTICULTURE

4/27. No. 637. Harvesting, Packing and Marketing of Deciduous and Tropical Fruits, by G. W. Marshall, Horticulturist.

8/27. No. 650. Coffee Culture in Southern Rhodesia, by G. W. Marshall, Horticulturist.

2/29. No. 725. Investigations into "Collar-Rot" Disease of Citrus, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad)

3/31.	No.	814.	Avocado Growing in South Africa, by Redvers J. Blatt, B.Sc., Ph.D.
11/31.	No.	834.	Celery Culture, by G. W. Marshall, Horticulturist.
1/32.	No.	843.	Vegetable Growing in Southern Rhodesia: Onion Culture, by G. W. Marshall, Horticulturist.
2/33.	No.	876.	Notes on African Aloes (Parts 1-6), by H. Basil Christian, "Ewanrigg," Arcturus.
10/33.	No.	905.	Notes on African Aloes (Parts 7-10), by H. Basil Christian, "Ewanrigg," Arcturus.
5/34.	No.	920.	Citrus Fruit Growing in Rhodesia, by G. W. Marshall, Horticulturist.
7/35.	No.	960.	The Rhodesian Home Orchard, by G. W. Marshall, Horticulturist.

ENTOMOLOGY AND PLANT PATHOLOGY.

2/13.	No.	139.	Termites, or "White Ants," by Rupert W. Jack, F.E.S.
6/15.	No.	214.	Some Household Insects, by R. Lowe Thompson, B.A.
2/21.	No.	385.	The Common Fruit Beetle, by R. W. Jack, F.E.S.
12/24.	No.	522	Notes on the Black Citrus Aphis, by C. B. Symes.
8/25.	No.	548.	Insect Pests of Cotton, by C. B. Symes.
9/27.	No.	653.	The Care of Tobacco Seed Beds, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad).
1/28.	No.	665.	Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.
2/28.	No.	671.	Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.
6/28.	No.	696.	Ticks Infesting Domestic Animals in Southern Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.
11/28.	No.	714.	Trap Cropping against Maize Pests, by Rupert W. Jack, F.E.S., Chief Entomologist.
12/28.	No.	718.	Preliminary Experiments on the Control of White Mould of Tobacco, by J. C. F. Hopkins, B.S. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
3/29.	No.	732.	Two Common Diseases of Potato Tubers in Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.
6/29	No.	742.	What is Diplodia in Maize? An Answer to a Popular Question To-day, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
8/29.	No.	748.	Frog Eye Disease of Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
9/29.	No.	753.	Leaf Spotting of Tobacco caused by Mosaic, by J. C. F. Hopkins, B.Sc (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
9/29.	No.	754.	"Pinking" of Maize: Report of a Preliminary Investigation, by T. K. Sansom, B.Sc., Plant Breeder.
6/30.	No.	784.	Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.

6/30. No. 788. A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.

A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist. Supplement No. 1.

7/30. No. 790. Notes on the Control of Some of the More Important Insect Pests of Citrus in Southern Rhodesia, by W. J. Hall, Ph.D., B.Sc., Entomologist to the British South Africa Company in Southern Rhodesia.

10/30. No. 796. The Army Worm (Laphygma exempta, Wlk.), by Rupert W. Jack, Chief Entomologist.

11/30. No. 798. The Preparation of Bordeaux Mixture and Seasonal Notes on Tobacco Diseases, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.

1/31. No. 804. Locusts in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.

8/31. No. 825. Some Common Diseases of Potatoes in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), Plant Pathologist.

3/32. No. 848. Mycological Notes: Seasonal Notes on Tobacco Diseases: 3, Frog Eye; 4, White Mould; by J. C. F. Hopkins, B.Sc. (Lond.).

4/32. No. 850. Pests of Stored Tobacco in Southern Rhodesia, by M. C. Mossop, M.Sc., Entomologist.

6/32. No. 856. A List of Plant Diseases occurring in Southern Rhodesia, Supplement 2, by J. C. F. Hopkins, B.Sc. (Lond.), Government Plant Pathologist.

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5/33. No. 893. Experiments with Tsetse Fly Traps against Glossina Morsitans in Southern Rhodesia, by R. W. Jack, Chief Entomologist.

6/33. No. 894. Mycological Notes. Seasonal Notes on Tobacco Diseases. 6. An Unusual Type of Frog Eye Spotting, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist.

6/33. No. 896. A List of Plant Diseases occuring in Southern Rhodesia. Supplement 3. (New Records for period June, 1932, to May, 1933.) Compiled by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist.

7/33. No. 897. The Report of the Chief Entomologist for the year ending 31st December, 1932, by Rupert W. Jack, F.E.S., Chief Entomologist.

8/33. No. 899. The Black Maize Beetle (Heteronchus Licus Klug), by C. B. Symes.

10/33. No. 904. Notes on the Biology and Control of the Red Locust in Southern Rhodesia, 1932-1933. Part I.: Control of Locusts, by R. W. Jack, Chief Entomologist. Part II.: Biological Notes on the Red Locust (Nomadacris septemfasciata, Serv.), by M. C. Mossop, A.F.C., M.Sc., Entomologist.

10/33. No. 906. The Locust Invasion of Southern Rhodesia, 1932-33, by R. W. Jack, Chief Entomologist.

2/34. No. 911. Screw Worm. A Pest of Ranch Cattle in Southern Rhodesia, by A. Cuthbertson, Entomologist. Foreword by R. W. Jack, Chief Entomologist.

3/34. No. 913. Locusts: Instructions for dealing with Flying Swarms, by The Division of Entomology.

4/34. No. 917. The Life History of the Screw-worm Fly, by Alexander Cuthbertson, Entomologist.

10/34. No. 934. Mycological Notes. Seasonal Notes on Tobacco Diseases. 7, Spraying in Seed-beds and Lands, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

12/34. No. 938. The Destruction and Control of Locust Hoppers, by R. W. Jack, Chief Entomologist.

1/35. No. 942. Mycological Notes. Seasonal Notes on Tobacco Diseases. 8, The Mosaic Mystery. 9, Danger Points in Field Spraying, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

4/35. No. 950. The Control of Tsetse Fly in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.

4/35. No. 951. Suspected "Streak" Disease of Maize. Notice to Growers, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

6/35. No. 957. Annual Report of the Branch of Plant Pathology for the year ending 31st December, 1934, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

8/35. No. 962. The Report of the Chief Entomologist for Year ending 31st December, 1934, by R. W. Jack, Chief Entomologist.

10/35. No. 969. The Objects and Value of Seed Treatment of Maize against Diplodia, by G. M. Wickens, Ph.D. (Lond.), D.I.C., Assistant Plant Pathologist.

5/36. No. 986. Annual Report of the Division of Entomology for year ending 31st December, 1135, by Rupert W. Jack, Chief Entomologist.

7/36. No. 993. Annual Report of the Senior Plant Pathologist for year ending 31st December, 1935. Part I.: Plant Pathology. Part II.: Tobacco Research, by J. C. S. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist and Officer in Charge of Tobacco Research Station, Trelawney.

12/36. No. 1011. Tick Infesting Domestic Animals in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist. Revised, November, 1936.

POULTRY.

1/29. No. 721. Poultry Keeping in Rhodesia: Pedigree Breeding, by H. G. Wheeldon, Assistant Poultry Expert.

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6/29. No. 740. Artificial Incubation, Breeding and Rearing of Chicks, by H. G. Wheeldon, Poultry Expert.

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11/32. No. 870. Trap Nests, by B. G. Gundry, A.I.MechE. (combined with No. 875).

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3/33. No. 884. The Vitamins in Poultry Feeding, by G. H. Cooper, Poultry Officer, Matopo School of Agriculture and Experiment Station.

5/34. No 918. The Moulting of Poultry: The Normal and Pullet Moult, by H. G. Wheeldon, Poultry Officer.

10/34. No 933. Ducks on the Farm (Revised), by H. G. Wheeldon, Poultry Officer.

12/34. No. 939. The Use of Galvanised Iron in the Making of Some Appliances for Poultry Keeping, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.

12/34. No. 940. A Cheap Portable Colony House for Poultry, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.

3/34. No. 947. Modern Culling of Laying Hens, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.

9/35. No. 966. Egg Marketing Bill: Draft of a Bill having for its purpose the more orderly Marketing of Eggs.

11/35. No. 971. Feeds for Poultry and How to Use Them, by G. H. Cooper, Assistant Poultry Officer.

The following pamphlets can be obtained from the Poultry Officer upon application:—

Selecting Birds for Laying Tests, by A. Little, Poultry Expert.

Tuberculosis, by A. Little, Poultry Expert.

Prevention of Disease among Poultry, by A. Little, Poultry Expert.

Preparing Birds for Show, by A. Little, Poultry Expert.

The Fowl Tick (Argas persicus), by A. Little, Poultry Expert.

Culling: A Seasonal Operation, by A. Little, Poultry Expert.

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Diseases of the Digestive System, by A. Little, Poultry Expert.

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Partial Moult: Broodiness. Selection of Layers of Large Eggs, by A. Little, Poultry Expert.

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Condition of Birds on Show, by A. Little, Poultry Expert.

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Seasonal Hints—August, by A. Little, Poultry Expert.
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METEOROLOGICAL.

12/22.	No. 436.	The Possibility of Seasonal Forecasting and Prospects for Rainfall Season, 1922-23, by C. L. Robertson, B.Sc., A.M.I.C.E.
12/24.	No. 524.	The Use of an Aneroid Barometer, by C. L. Robertson, B.Sc., A.M.I.C.E.
2/25.	No. 532.	The Short Period Forecast and Daily Weather Report, by C. L. Robertson, B.Sc., A.M.I.C.E.
6/25.	No. 542.	Review of the Abnormal Rainfall Season, 1924-25, by C. L. Robertson, B.Sc., A.M.I.C.E.
10/28.	No. 712.	The Time, and How to Find It, by N. P. Sellick, M.C., B.Sc. (Eng.).
10/31.	No. 832.	The Weather Map and the Short Period Weather Forecast, issued by the Meteorological Office.
2/33.	No. 877.	Clouds and Weather in Southern Rhodesia, by N. P. Sellick, M.C., B.Sc., Meteorologist.
3/35.	No. 948.	The Weather, contributed by The Meteorological Office.

AGRICULTURAL BUILDINGS.

9/25.	No. 554.	Pisé-de-Terre, by P. B. Aird.
4/26.	No. 588.	Concrete on the Farm, by N. P. Sellick, M.C., B.Sc. (Eng.), Assistant Irrigation Engineer.
8/26.	No. 605.	Flue-curing Tobacco Barns. Bulking and Grading Sheds, by P. H. Haviland, B.Sc. (Eng.), Acting Government Irrigation Engineer.
5/27.	No. 644.	Tobacco Baling Boxes, by B. G. Gundry, Irrigation Branch.
11/27.	No. 661.	Flue-curing Tobacco Barns, 12 ft. x 12 ft. x 16ft., by B. G. Gundry.
10/32.	No. 863.	Piggeries, by B. G. Gundry, A.I.Mech.E.

5/33. No. 889. The Construction of Dipping Tanks, by B. G. Gundry, A.I.Mech.E.; and Notes on their Management, by J. M. Sinclair, M.R.C.V.S., Chief Veterinary Surgeon.

9/33. No. 902. Brick-making on the Farm, by A. C. Jennings, Assoc.M.Inst.C.E.

12/33. No. 908. A Charcoal Safe or Cooler, by B. G. Gundry, A.I.Mech.E., Irrigation Division.

5/34. No. 922. Dairy Building in Southern Rhodesia: A Small Farm Dairy, by B. G. Gundry, A.I.Mech.E.

7/34. No. 926. Dairy Buildings in Southern Rhodesia. Cow Byre—Type II., by B. G. Gundry, A.I.Mech.E.

8/36. No. 996. The "Gundry" Tobacco Furnace, by B. G. Gundry, A.I.Mech.E.

10/36. No. 1002. A Simple Farm Gate, contributed by the Division of Forestry.

CHEMISTRY.

12/29. No. 762.—The Value of Rock Phosphate and "Bone and Superphosphate" as Fertilisers for Maize Production, by A. D. Husband, Chief Chemist.

4/32. No. 852. Mixing of Fertilisers: A Guide to Methods of Calculation, by the Division of Chemistry.

7/32. No. 858. The Softening of Waters, by the Division of Chemistry.

1/34. No. 910. The Toxicity to Grazing of Grass Sprayed with a Solution of Sodium Arsenite, by A. D. Husband, F.I.C., and J. F. Duguid, M.A., B.Sc.

9/34. No. 930. Analyses of Rhodesian Foodstuffs, by The Division of Chemistry.

4/35. No. 949. Report of the Branch of Chemistry for year ending 31st December, 1934, by A. D. Husband, F.I.C., Chief Chemist.

5/35. No. 954. Experiments on the Toxicity to Fowls of Arsenite of Soda and Poisoned Locusts, by J. K. Chorley, F.R.E.S., and R. McChlery, B.A., B.Sc.

4/36. No. 983. Annual Report of the Branch of Chemistry for year ending 31st December, 1935, by A. D. Husband, F.I.C., Chief Chemist.

MISCELLANEOUS.

4/28. No. 686. The Land Bank, Its Functions and How it Operates, by S. Thornton.

4/28. No. 687. The Use of Explosives on the Farm, by P. H. Haviland, B.Sc. (Eng.).

7/28. No. 702. Book-keeping on the Farm, by T. J. Needham, Acting Accountant, Agricultural and Veterinary Departments.

9/28. No. 707. Wood-Charcoal in Southern Rhodesia, by T. L. Wilkinson, B.Sc., Assistant Forest Officer.

5/31. No. 820. The Great Economic Problem in Agriculture—No. 1, by J. R. McLoughlin, M.Sc. (Economics), Economic Adviser.

6/31. No. 823. The Law of Supply and Demand—No. 2, by J. R. McLoughlin, M.Sc. (Economics), Economic Adviser.

3/32. No. 849. The Preservation of Farm Beacons, by L. M. McBean, Acting Surveyor-General.
How to Make Use of the Fencing Law.
Twelve Simple Rules for the Avoidance of Malaria and Blackwater.
Summary of the Game Laws of Southern Rhodesia.

11/34. No. 935. The Weeds and Poisonous Plants of Southern Rhodesia, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture. Part I.

6/35. No. 958. A Cheap Levelling Device, by A. W. Laurie, Howick Vale, Concession.

8/35. No. 961. A Home-made Ridger. Contributed by Mr. Douglas Aylen, Somerset, Concession.

1/36. No. 975. Fertilizers, Farm Foods, Seeds and Pests Remedies Ordinance, 1914.

2/36. No. 979. The Prospects of Black Bass in the Inland Waters of Southern Rhodesia. Specially contributed.

6/36. No. 991. Silage and Silos.

8/36. No. 997. Reward Wheat: Report on the Baking Properties and Chemical Analyses, by The Rhodesian Milling and Manufacturing Co., Ltd.

8/36. No. 998. Summary of the Game Laws of Southern Rhodesia.

3/37. No. 1017. The Conditions Governing the Hire of Government Boring Machines.

3/37. No. 1018. Veld Fires. The "Forest and Herbage Preservation Act, 1936," by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Chief Forest Officer.

3/37. No. 1021. Breaking in Young Oxen to the Yoke, by J. B. West, Dromoland, P.B. Lonely Mine.

NOTICE

The Agricultural Journal of S. Rhodesia

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A 10/- note will cover the subscription for two years.

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If payment is made by a cheque drawn on a bank outside Rhodesia, commission must be added.

All cheques and postal notes must be made payable to the Secretary for Agriculture and Lands.

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Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

To the Housewives of Bulawayo.—As from July 1st, 1937, consumers of meat in Bulawayo will be able to purchase choice beef graded by a Government Grader and marked as such either on the surface of the meat or on the invoice.

The scheme is to be put in operation in co-operation with the butchers of Bulawayo, and consumers, who wish to be certain of the quality of beef they buy, should ask for Government graded "choice beef."

In asking for beef of this quality consumers will help the producer of better cattle and also secure beef that is nutritious and tender.

The scheme is a trial one and its continuance will depend on the support of the public. Your co-operation is therefore earnestly requested.

All those interested should ask their butcher for this beef. Specify "choice beef" Government graded in the order book to ensure satisfaction and limit grumbling from the family.

Sprouted Grain for Fodder.—Messrs. British Cultivations, Ltd., of London, presented a twin-unit "Vitaplant" cabinet to Hawkesbury College, New South Wales, so that official tests could be made of the Spangenberg fodder process of producing sprouted grain. The full report on the tests appears in the March and April numbers of the *N.S.W. Agricultural Gazette.*

The cabinet was heated by electricity and the costs involved in producing one ton of sprouted maize fodder were as follows:—

Maize, 15.36 bushels @ 5s. per bushel, £3 16s. 9d.; 372.7 units of electricity @ 3d., £4 13s. 6d.; labour, 20.48 hours @ 1s. 5d., £1 9s. 1d.; total, £9 19s. 4d., without counting interest, depreciation or "Nutrisal," *i.e.*, the patented nutrient used. These figures are given to enable farmers to calculate approximately what the costs would be under local conditions. The following is the summary given in the *N.S.W. Agricultural Gazette*:—

"The report deals with investigations at Hawkesbury College, Richmond, New South Wales, into the operation and practical application of the Vitaplant cabinet for sprouting fodder according to the Spangenberg process, maize being the main crop used. A resumé is given of the work leading up to the invention, the claims of the inventor, together with the principle and operation of the cabinet. Difficulties experienced included uneveness of flooding, temperature and yield, mould development, slime formation, and patchy germination. Growth reached an average height of 5 to 6 inches in six days, of a fairly even green colour, and the average daily output of the cabinet was 218 lbs. of fodder from 84 lbs. seed.

Fodder produced, including shoots, roots and seed, averaged two and a half times the weight of the original seed, with moisture content, in six days, of 79 per cent. Seeding rates of 6 lb. and 8 lb. per tray were compared, and 8 lb. gave the best results. Cost of producing 1 ton of fodder, over a thirty-four day period, was £10, without making charges for interest, depreciation and 'Nutrisal.' Seedlings of maize, sorghum, wheat, barley, field peas and Japanese millet were successfully transplanted from the cabinet to the field. Surplus nutrient solution from the cabinet gave excellent impetus to growth of salvia, lettuce, cucurbits, and rye grass. In addition to maize, the following crops were successfully produced in the cabinet: Wheat, barley, rye, Japanese millet, sorghum and field peas. Practical application of the process for producing fodder would be dependent upon a greatly reduced cost of production. As an adjunct to market gardening practice and plant breeding work, a small model of the Vitaplant cabinet might be of use for preparing seeds for transplanting."

Farm Compost.—Mr. W. A. Albrecht, in Bulletin 369 of the Missouri Experiment Station, reports "that such materials as straws, cornstalks, cotton hulls and other organic residues were composted easily by adding 67.5 lb. of ammonium sulphate, 60 lb. of fine limestone, and 22.5 lbs. of superphosphate per ton dry matter. It was found practicable to add the mineral nutrient mixture while the straw, for example, is coming from the thresher. When piled to a height of 6 ft. with flat top so as to take the rain, the decay will proceed as the moisture allows. Such composting may also be done by hand, but it is less laborious when the chemicals are applied through the machine as the thresher, which mixes them more effectively. Farm trials of the resulting manure warrant wide consideration of this process as a help in getting more organic matter into the soil."

Granadilla Growing.—The following note taken from the March number of the *Queensland Agricultural Journal* will probably be of interest to many readers. It should be mentioned perhaps that considerable difficulty has been

experienced in getting granadilla cuttings to strike in this country. It would be appreciated therefore if anyone who has been successful would supply this *Journal* with a note giving particulars or the type of cutting used and the date of planting.

"In the growing of granadillas it is most essential that suitable trellising be erected to carry these plants.

"The most successful method noted is to plant cuttings (decidedly preferable to the planting of seed) in the field at a distance of 16 feet between each cutting in the rows, and 6 to 8 feet between each row. A wise plan is to plant a greater number of cuttings in each row than are actually required, the grower removing any surplus after a reasonable period has elapsed, such period being long enough for these young vines to take root, and thus establish their certainty of growth. It is necessary for these vines to be trained up on to a trellis and a trellis is erected above them in the following manner:—

"Two straining posts, one at each end, are very securely erected. Supporting posts are placed between these two posts at intervals of from 12 to 14 ft. The main wire is strained through the middle of these posts at approximately 5 ft. from the ground. At the top of each of these posts an arm is fastened (a piece of 3 x 2 timber 3 ft. long is ideal for this purpose). Two holes are bored (one in each end), and two additional wires are strained through these holes, thus making a 3-wire trellis to carry the vines.

"It is imperative that these vines be trained so that the main leader grows along each of these wires, and it is preferable to have all vines running in the one direction.

"Under tropical conditions these vines should come into fruit in approximately eight months. The first crop would be somewhat light; the second crop should be much heavier, and from then on these vines should produce two crops per annum.

"The amount of fruit produced is greatly increased if hand pollination is adopted, and although this is quite a tiresome and difficult procedure, it gives results that easily repay the grower.

"It is particularly hard to estimate the actual weight of fruit produced per acre per annum, as so many factors are

responsible. The best granadillas produced in Queensland are from vines growing on the rich alluvial lands just north of Cairns, and fully considering this fact it would appear that in districts as far south as Mackay similar returns would be obtained."

The Effect of Rainfall on the Quality of Tobacco.—Experiments carried out on flue-cured tobacco at the Duke University, Durham, North Carolina, some time ago indicated without doubt that under conditions prevailing in the different tobacco producing areas of the United States of America, the amount of rainfall during the growing period exercises a considerable influence on the quality of tobacco produced. It should be pointed out, however, that forty inch rainfall is looked upon as low, and fifty inch or more as high rainfall. In these conditions excessive rainfall produces thin, light-coloured, light-bodied tobaccos, of increased carbohydrate content and a lower percentage of nicotine, petroleum ether extract, and total nitrogen, as well as a reduction in the percentage of total nitrogen which is soluble. Deficient rainfall produces thick, hard, gummy, dark-coloured tobacco of decreased sugar content, greatly increased nicotine, and an increased percentage of total nitrogen that is soluble. Below-normal rainfall is not quite sufficient for normal plant development. Above-normal rainfall is slightly more than is required for best tobacco quality. If either of these conditions is experienced the changes in composition and quality will be in the directions previously indicated, but these departures from normal are not sufficient to damage the quality of the crop materially.

Excessive rains coming late in the season, after a dry period, may cause the maturing crop to renew growth. Such tobacco is very poor in texture, colour and smoking quality. Such tobacco may have a composition analogous to that produced under very deficient rainfall. The differentiation is most manifest in a greatly increased amino nitrogen content in these second-growth tobaccos.

Young Farmers' Club.—The Young Farmers' Club movement originated in the United States of America many years

ago and has become so popular there that there are now over 50,000 clubs with a membership of nearly three-quarters of a million. It was not until 1921 that the movement started in England, but there are now about 200 clubs, and these have been grouped under a national Federation with the Duke of Norfolk as President. Branches have been formed in Ireland, Scotland, Wales, Canada, Australia, New Zealand and Nigeria.

The Young Farmers' Clubs are open to boys and girls between the ages of 10 and 21. Every member has to undertake some small agricultural enterprise such as the rearing of a calf or a pig, the cultivation of a garden plot or the keeping of a number of poultry, a hive of bees, or a few rabbits. But the most important undertaking is that the job must be regarded as a business and be run on a business line. Accounts have to be kept and these are discussed at the club meetings, where all the office-bearers are chosen from the club members. Older persons are welcome at the meetings and can take part in the discussions, but they are not allowed to hold office nor to vote on any club matter.

Professor J. A. S. Watson, writing on Young Farmers' Clubs in *The Listener* some time ago, gave a very clear picture of the activities of some of the Young Farmers' Clubs in England. He wrote, *inter alia*, "Somebody said to me lately, 'This Young Farmers' business is just playing at farming ; so it is. But a good game is surely well worth playing, and played in the right spirit is surely one of the finest things in the world. I've seen a good deal of this Young Farming. It is a good game, and like all games in these days it is played very seriously. Already it is played well by a good many young people, somewhere between three and four thousand; and what I am so anxious about is just that ever so many more —thirty, forty or a hundred thousand—should be given a chance to play. And that is just why we want your help."

An Outline of Cytological Technique for Plant Breeders.— As Sir Daniel Hall says in a brief foreward to this bulletin, a knowledge of cytology and some acquaintance with its technique has become essential to the plant breeder. The aim of the publication is to give an account of the standard

methods used in plant cytology and it is based on practical experience with these methods rather than on a survey of the literature.

After an introduction dealing with the value of cytology in plant breeding and some general remarks on technique, the bulletin describes in turn the various methods of fixing and staining which have been proved to give good results. Hints are given on the use of the microscope, and the bulletin concludes with a list of fixatives with formulae and a short bibliography.

While the bulletin has been prepared for the benefit of plant breeders, it is, of course, equally suitable for anybody wishing to learn these standard methods; the modest price (1s. 6d.) is worth mention in this connection.

Turkish Tobacco.—Growers Please Note.—The attention of growers of Turkish tobacco is drawn to the provisions of Section 3 of the "Turkish Tobacco Export Act, 1936" whereunder it is provided that every grower who wishes his Turkish tobacco to be exported to the Union of South Africa in the forthcoming quota year should make application in writing to the Minister of Agriculture and Lands for an export quota.

Any grower who wishes his tobacco to be exported to the Union of South Africa during the quota year ending 30th June, 1938, but has failed to make application for an export quota should do so on or before 18th June, 1937.

No application received after the 18th June, 1937, can be considered.

New Branding Regulations.—Considerable thought has recently been given by the Department to the question of endeavouring to improve the market standard of Southern Rhodesia hides, with the object of bringing about a consequential increase in the receipts derived from this product.

From particulars which have been obtained of this industry it appears that during the period 1927 to 1935 inclusive hides and skins to the average value of £118,125 were exported from the Colony. The actual figures were:—

1927	£180,440
1928	303,211
1929	152,046
1930	88,550
1931	49,041
1932	31,517
1933	62,548
1934	90,138
1935	105,638
Total	£1,063,129
Average	£118,125

This clearly illustrates the importance of the hide and skin industry to the Colony.

In many cases the hide, if not branded on its more valuable parts, and provided that it is properly handled and cured, represents up to 50 per cent. of the value of the whole beast, and it is conservatively estimated that the practice of branding on the most valuable portions of the hide is responsible for a depreciation in value of our hides of probably 25 to 30 per cent. This represents a sum in the vicinity of £25,000 to £35,000 per annum.

One of the largest tanners in England commented as follows on our hides:—

"All our customers who have had them are complaining of the very heavy branding of these hides. The hides have two or three letters on the hip and in addition two or three on the forepart of the hide, but not on the shoulder (neck), so that the whole of the branding comes on the best part of the leather. If the brand were on the cheek or shoulder (neck) this would add another 1s. or 2s. per hide to the value."

In view of such comments and the annual loss which arises due to the impression of brands on unsuitable parts of the hide, new regulations were drafted and submitted by the Secretary of this Department to all the organisations in the Colony interested in cattle, and to a number of the managers of ranchers and larger cattle farmers.

The alterations suggested received the unanimous support of everyone concerned and where therefore accepted by the Government and published in Government Notice 325 dated 21st May, 1937. The regulation regarding branding therefore now reads :—

"In the case of cattle the first brand shall be imprinted on the near cheek or near side of the neck. The second brand on the off cheek or off side of the neck. The third brand on the near shoulder and below the point of the shoulder. The fourth brand on the off shoulder and below the point of the shoulder. The fifth brand on the near hind thigh below the stifle joint. The sixth brand on the off hind thigh below the stifle joint. In the case of subsequent brands they shall be imprinted on the parts of the beast in the order named above immediately above the previous imprint."

THE MAIZE CONTROL ACT, No. 6 of 1937.

By E. R. Jacklin, Chairman, Maize Control Board.

The Editor of the *Journal* has asked me to give him a a reasonably short note on the new Maize Control Act explaining the various points on which it differs from the previous legislation. Unfortunately, however, a detailed explanation of all the points of difference would take up a great deal of space, and a number of the alterations while important from the point of view of the administration of the control system are mere re-drafts of existing provisions and do not introduce any new principles.

The Act is primarily a consolidation of the Act of 1931 and of the four subsequent amendments. The first of these amendments was effected in 1933, the purpose being to tighten up the control system and to improve the wording of certain Sections which had been found to provide opportunity for evasions. In the following year a second Amendment Act withdrew the exemption applying to certain districts and introduced the quota system. In 1935 a very short Act extended the life of the control to 31st May, 1936, and gave trader-producers the right to a certain participation in the Local Pool; finally in 1936 another short amendment extended the control for a further year.

Consolidation of these various enactments was desirable so that the law might be more easily understood by the producers and other interests affected, and this process of consolidation necessitated a complete re-arrangement of the clauses and to a considerable extent a re-drafting. In the new Act the various features in the control system are set out in a consolidated and consecutive form so that it is now easy for each class of person affected by the legislation to ascertain in a few moments exactly what are his obligations and rights under the Act.

Of the amendments introduced by the new Act, the most important from the producers' point of view is that which relates to the manner in which participation in the Local Pool is arranged. It was provided in the "Quota Act" of 1934 that an excess of sales in the local market over the quantity of maize received on quotas should be applied first to increase the participation of the Group 11 growers from 25 per cent. of their "average sales" to the level of the Group 10 growers, 30 per cent.; secondly, to increase Groups 11 and 10 from 30 per cent. to the level of Group 9, 35 per cent.; next to increase the three Groups 11, 10 and 9 from 35 per cent. to the level of Group 8, 40 per cent., and so on. The process continued right up the scale until the whole quantity of the excess of sales was absorbed. It will be remembered that this system gave the large growers a quota adjustment up to 43.748 per cent. of their "average of sales" in 1934-35 and 59.4 per cent. in 1935-36. The final figure for the pool year 1936-37 has not as yet been determined, but it is certain that it will again represent a substantial increase over the statutory percentages.

The new Act prescribes that for the future the adjustment process described above shall be applied until Groups 11 and 10 have had their percentages made equal to that of Group 9, namely, 35 per cent. At this stage, however, the process is interrupted. Before any further increase can be given to the big growers the remaining balance of the excess of sales must be used to increase the percentage of all the remaining groups equally until, if the surplus allows, all such percentages are increased by 5 per cent. If after this adjustment any balance of the excess of sales remains unapplied, the process prescribed in the previous Act is resumed; Groups 11 and 10 will have their 35 per cent. increased to the percentage of Group 9, as adjusted by the 5 per cent. increase referred to above. Groups 9, 10 and 11 will then be brought up to the adjusted level of Group 8, and so on up the scale.

Another important alteration is concerned with the manner in which the quota participation of native producers is to be calculated. The previous Act required that the quota percentage of native producers in any year was to be equal to the proportion of the total deliveries by non-natives which participated in the Local Pool in the previous year. This

arrangement created the anomaly that when a good year followed upon one in which a short crop was reaped the natives would have a very much higher quota percentage than the Europeans, while in a short year following upon a good one the reverse would be the position. Under the new arrangement the natives' percentage will be the same as that obtained by the non-Europeans in the mass in the same year.

The natives' quota was in the first instance based on the previous year so as to make it possible to determine immediately the native delivers his maize exactly what part of it will share in the Local Pool. Under the new arrangement it will not be possible to fix the native percentage until the end of the pool year because the quantity of maize sold in the local market will not be established earlier. For this reason the Act provides for a provisional percentage being given when the maize is delivered and for subsequent adjustment of the figure as circumstances permit.

Another alteration which has caused some discussion is the provision in Section 17 (4) of the Act, which permits of a grower's quota being reduced or cancelled "if the Board is satisfied that such procedure is just and equitable." This does not necessarily mean that there must be any general reduction or cancellation of quotas. It will, however, permit of the quotas of growers who have left the country or who are no longer farming, being cancelled in the Board's Register. It will also enable the Board to review the quotas of growers who have transferred from large to small farms and whose quotas are consequently out of relation to their new circumstances.

The Effects of Feed
ON THE FIRMNESS AND GRADING OF BACON CARCASES.

An experiment carried out by the Division of Animal Husbandry in co-operation with Mr. A. L. Millar, Estes Park, Salisbury, and Mr. Frank Neill, of Neill's Bacon Factory, Salisbury.

The question of soft fat still remains a live issue, and a good proportion of the pigs delivered at Neill's Bacon Factory are graded "soft" or "rather soft."

Some feeders attribute this softness to the using of protein feeds such as carcase meal, meat meal and bloodmeal instead of separated milk, which is supposed to give a much firmer carcase. The causes of softness in the fat were outlined in a previous publication of this Division(1). It was shown that where oily foods have not been used in the vast majority of cases the softness can be attributed to lack of finish. In order, however, to obtain more local evidence on this point it was decided to carry out the present experiment.

Description of Pigs and Rations Used.—Forty weaners of an average age of four months and of 65 lbs. liveweight were selected for the experiment. All the weaners were by the same Large White boar out of Large Black sows of a useful type. The young pigs were divided into five groups of eight each and fed rations made up as follows:—

Group 1.
200 lbs. maize meal.
6 lbs. bone meal.
2 lbs. salt.
plus ½ *gallon separated milk* per pig per day.

(1) Romyn, A. E., Investigation into the Causes of a Number of Soft Pigs. R.A.J., July, 1936.

Group 2.

180 lbs. maize meal.
20 lbs. *carcase meal.*
6 lbs. bone meal.
2 lbs. salt.

Group 3.

185 lbs. maize meal.
15 lbs. *meat meal.*
6 lbs. bone meal.
2 lbs. salt.

Group 4.

132 lbs. maize meal.
60 lbs. *Palm Kernel cake.*
8 lbs. meat meal.
6 lbs. bone meal.
2 lbs. salt.

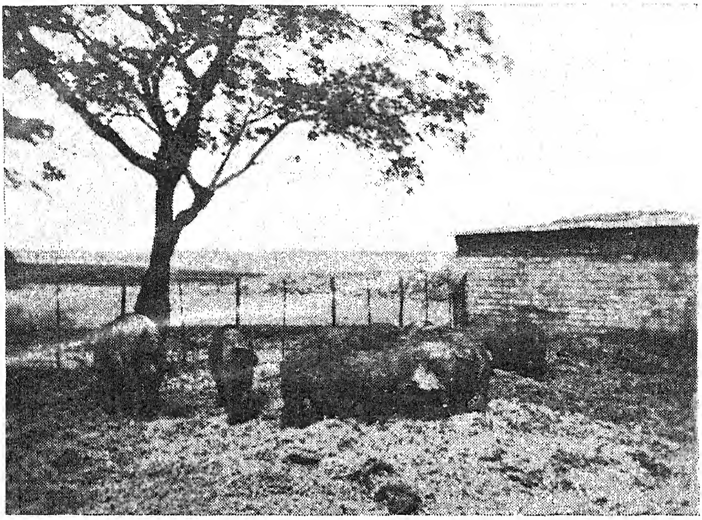
Group 5.

185 lbs. maize meal.
15 lbs. *blood meal.*
6 lbs. bone meal.
2 lbs. salt.

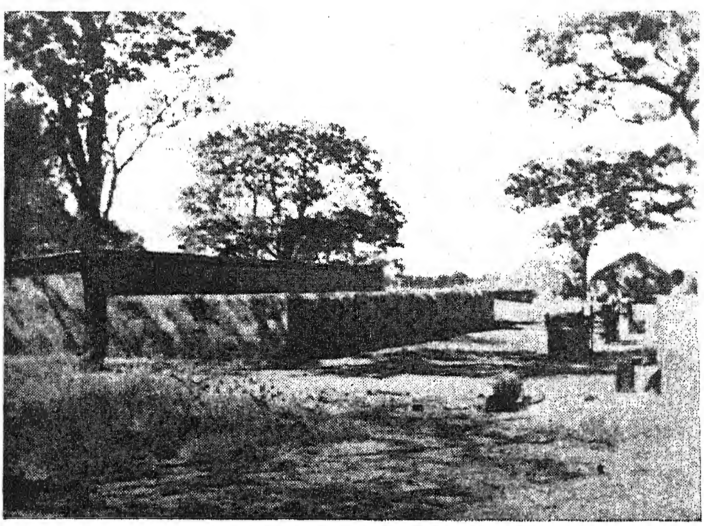
The carcase meal and meat meal are the products of two different firms. The meat meal is the more concentrated product, not containing so much bone meal and had a protein content of approximately 75 per cent. as compared with 50 per cent. in the carcase meal.

All the pigs were fed the concentrate ration in as large quantities as they would clean up. A record was kept by Mr. Millar of all the concentrated feed used for each lot. Green feed consisting of green grass, wintersome or green maize tops was fed in between the concentrate feeds. The grain was given in a slop. The pigs were housed in sties with concrete floors, which were kept in a sanitary condition throughout.

The Marketing of Pigs.—The pigs were marketed in three separate lots when ready. They averaged 183 lbs. live weight on the farm at the final weighing. A few lighter pigs, which on their appearance were rather unfinished were included in the last two consignments in order to test the effect of lack of finish on the firmness of the fat.



The Breeding Herd.



The sties showing also the feed bins for this experiment on the left.

Records Kept.—Records were kept by Mr. Millar of the weight of all the feed consumed and the pigs were weighed periodically to determine their gain in live weight. After 38 days of feeding the experimental pigs were inspected by Mr. Frank Neill, who advised that one pig in each group, which was of a pronounced porker type, should be eliminated. These five pigs were taken out and sold as porkers and the data shown in Tables 1, 2 and 3 cover only the seven pigs left in each lot, except that the data in regard to feed consumption includes all the pigs.

On arrival at the Bacon Factory every pig was weighed and marked. Carcases were graded by Mr. Frank Neill. The grading took place after the carcases had been chilled for about 24 hours. Firmness of fat was determined by the feel of the back fat when pressed with the thumb, and the degree of fatness was determined by measurement at the deepest point of the fat over the shoulder. A sample of the back fat of each pig was taken as a check on the physical grading and the iodine numbers of these fat samples were determined by the Division of Chemistry.

Results.—The daily rate of gain in live weight and the feed consumption per 100 lbs. of increase in weight for the five different groups of pigs is shown in Table 1.

TABLE 1.

Gain in Live Weight and Feed Consumption of Pigs.

No. of Group	No. of pigs in group.	Avge. initial weight.	Avge. final weight.	Avge. total gain.	Avge. daily gain.	Avge. No. days fed.	†Avge. lbs. concentrates per 100 lbs. gain in live weight.
1	7	66	178	112	1.62	69	327*
2	7	65	183	118	1.71	69	297
3	7	65	182	117	1.69	69	309
4	7	66	195	129	1.50	86	304
5	7	65	178	113	1.59	71	342

†Includes the porker pigs eliminated at 38 days.
*Plus 31 gallons separated milk.

All the rations proved satisfactory and the amount of feed shown per 100 lbs. increase in live weight is low in all groups and very low in some. No account was taken of the amount of green feed consumed. Group 1 (separated milk) and Group 5 (blood meal) did not use their feed as economically as the other three groups. In the case of Group 1, this is probably explained by the individuality of the pigs, which never seemed to settle down as well as the other groups. In Group 5, however, it does appear that the pigs did not use their feed as economically as the others. Group 4 (palm kernel cake) made slower gains than the other groups and took on a average between two and three weeks longer to finish. The gains made were, however, very economical. It is probable that the percentage of palm kernel cake (30 per cent.) is rather high, as the pigs could not consume as much grain per day as the other groups did. It is possible that if the percentage of palm kernel cake had been lowered to 15 per cent. to 20 per cent. the pigs would have gained more rapidly and would still have retained their desirable firmness.

If separated milk is reckoned at a 1d. per gallon, not an ınfair value, the most expensive ration is that fed to Group 1. t current prices there is very little difference in the unit cost f the other four rations. The groups that cost the most to ed are Nos. 1 and 5, due in the case of Group 1 to the cost separated milk and the higher feed consumption, and in the se of Group 5 to the comparatively large amount of feed ed per 100 lbs. increase in live weight.

The Factory gradings of the pigs are shown in Table 2.

TABLE 2.

e Carcase Gradings of the Pigs at the Factory and Iodine Numbers of the Back Fat.

up.	Very firm.	Firm.	Fairly Firm.	Rather Soft.	Soft.	Iodine numbers of fat.
1	2	1	2	2	—	60.8
2	3	2	2	—	—	60.8
	3	3	1	—	—	59.9
	6	1	—	—	—	58.9
	4	1	—	2	—	61.1
	—	—	—	—	—	——
	18	8	5	4	0	

From a study of Table 2 it will be noted that Group 4 (palm kernel cake) was definitely the firmest of the five groups. There is no very great difference between any of the other groups, though Group 1 (separated milk) might be taken to be a little less firm than the others. No pigs were graded "soft." Four pigs were graded "rather soft." These four pigs were four pigs deliberately despatched to the Factory underweight in order to test the effect of lack of finish. The two "rather soft" pigs in Group 1 averaged 161 lbs. live weight as compared with 182 lbs. for the other pigs in Group 1. The two "rather soft" pigs in Group 5 averaged 168 lbs. live weight as compared with 182 lbs. for the other pigs in that group. The effect of finish on the firmness of the fat is further borne out in a general way by a study of the weights of the pigs. In general the heavier the pigs the better they were finished. The 26 pigs graded "firm" and "very firm" averaged 186 lbs. live weight. The five pigs graded "fairly firm" averaged 180 lbs. and the four pigs graded "rather soft" averaged 165 lbs., showing a general tendency for the pigs to become firmer as they become heavier and more finished. The well finished pigs were all firm while the "rather soft" and "fairly firm" pigs all lacked somewhat in finish. The "rather soft" pigs were definitely unfinished.

The physical grading of the pigs for firmness is confirmed by the iodine numbers as shown in Table 2. It must be explained that the higher these numbers the softer the fat, so that Group 4 with an iodine number of 58.9 should be firmer than Group 5 with an iodine number of 61.1. This difference is, in fact, in line with the physical gradings shown in Table 2, and in most cases there was a good correlation between the iodine number and the grade given to the pig on the examination of the carcase. The highest iodine number was 64.3, which is just over the figure of 64, which is usually taken to set the limit of firmness.

The depth of back fat in the different groups is shown in Table 3.

TABLE 3.

The Depth of Back Fat of the Pigs.

Group.	$2\frac{1}{2}$in.	$2\frac{3}{8}$in.	$2\frac{1}{4}$in.	$2\frac{1}{8}$in.	2in.	$1\frac{7}{8}$in.	$1\frac{3}{4}$in.	$1\frac{5}{8}$in.	$1\frac{1}{2}$in.	Avge.
1	—	2	1	2	1	1	—	—	—	2.16″
2	1	—	2	2	1	—	1	—	—	2.14″
3	1	—	—	2	2	2	—	—	—	2.07″
4	—	—	—	1	2	1	1	1	1	1.83″
5	1	—	1	—	—	—	5	—	—	1.93″

It will be noted that Group 5 (blood meal) and Group 4 (palm kernel cake) are the two leanest groups. There is not much to choose between the other three groups, except that Group 1 (separated milk) might be taken to be a little fatter than the others. The number of pigs concerned is, however, too small to give any significant result. When grading the pigs, any that measured over $2\frac{1}{4}$ inches at the shoulder were graded as overfat. Two pigs measuring $2\frac{1}{4}$ inches, which were rather lacking in length, were also graded as overfat. The best proportioned group on the whole appeared to be Group 4 (palm kernel cake), in which all the pigs showed good length and excellent bellies.

Discussion.—The chief value of this experiment has been to illustrate the importance of "finish" in determining the proper time to market the baconer. As far as the local market is concerned practically all firm pigs could be produced on any one of the rations used in this experiment, provided the pigs are marketed when they are properly finished. Oily feeds cause soft bacon, but apart from the use of such feeds probably most of the pigs graded "soft" at the Factory to-day are soft owing to lack of "finish" or unthriftiness.

A pig should not be marketed until it is firmly and evenly fleshed. Some pigs, the early maturing ones, reach this stage at a live weight of 160 lbs., whereas others, of a leaner type, have to be carried on to 200 lbs. before they have the right depth of fleshing. The feeder who markets his pigs at a constant weight, without consideration of their type, is liable to get either soft or overfat pigs. Some pigs again are too fat ever to make good baconers. These should be sold as porkers when they reach porker weights, as was done with the five pigs in this experiment, which were rejected by Mr. Neill when they weighed 100 to 120 lbs.

Conclusions.—The general conclusions drawn from this experiment are:—

(1) Provided no oily feeds are used, under our conditions "finish" is a more important factor than feed in determining the firmness of the carcase.

(2) All the rations used in this experiment produced firm carcases. The four carcases which were soft were produced from pigs which were definitely unfinished.

(3) Palm kernel cake has a firming effect on the fat.

These conclusions are not new, but simply bear out the experience of pig feeders elsewhere.

The thanks of the Department of Agriculture are due to Messrs. A. L. Millar and F. Neill for their valued co-operation.

COMPOST.

A NOTE ON METHODS OF REDUCING THE COSTS.

By S. D. Timson, M.C., Assistant Agriculturist.

Farmers all over the Colony have taken up the manufacture of compost manure during the past year, some of them on a large scale. The chief obstacle to its general adoption into farm routine is the question of the economical collection of the raw materials required for making it, such as grass and sunnhemp.

Below the writer wishes to introduce to the notice of farmers two simple and inexpensive implements, which will go a long way towards solving the difficulty.

The Hosier Hay Sweep.—This implement was invented by Mr. A. J. Hosier, the pioneer of the open air milking system, and is being increasingly used by farmers in Great Britain, where it has been most successful.

The writer introduced this implement to the notice of Mr. A. S. Laurie, of Concession, who immediately appreciated its possibilities, imported one, and with his usual public spirit arranged a demonstration of its working on his farm Somerset. Unfortunately very few farmers took advantage of this opportunity to see it in action, but it clearly proved its suitability to Rhodesian conditions.

On an earlier occasion Mr. Laurie kindly gave a demonstration to the writer of its ability to sweep up a crop of sunnhemp hay, which was lying in windrows, and the accompanying photographs show it in action on this occasion. The sweep was attached to an old Ford half-ton lorry and it moved over the uneven ground and along the sides of contour ridges without difficulty and swept the sunnhemp into large loading dumps at a remarkable speed.

The writer was greatly impressed with the work done by this implement, and he can strongly recommend it for use on ordinary farm fields in this Colony in sweeping grass and sunnhemp for composting or, of course, for hay.

With regard to its capacity Mr. Laurie writes as follows: "As regards work done: In three and a half days of easy going the sweep easily cleaned up 60 acres of land. Ten boys were building stacks and simply could not keep pace with it, and so it had to stand still much of the time."

"I am very pleased with the work done by the sweep (much of it on rough going); it saved endless time and labour, and my anxieties regarding sufficient winter fodder for live-stock in future are a thing of the past, *and I should think for making compost it will prove just the very thing for collecting the material where and when required. No more ploughing under of sunnhemp in future, I am thinking.*"

The sweep is made in the following sizes and prices in England. The manufacturers are Messrs. Hosier Inventions, Ltd., Wexcombe, Marlborough, Wilts.

7 tines (6 feet wide) for light cars ... ... price	£5	15	0
9 tines (8 feet wide) for 16 h.p. cars... ... price	£6	10	0
11 tines (10 feet wide) for cars over 16 h.p., price	£7	10	0

The handling and forwarding charges from Beira to Concession amounted to £1 3s. 0d. Spare tines cost 5s. 6d. each.

Mr. Laurie's sweep is a 9 tine model, but he thinks that possibly a 7 tine model might be more economical under local conditions, since it would probably allow the car to be driven on a higher gear.

Not only should this sweep go far to solve the problem of economically collecting the sunnhemp crop for composting, but it should enable farmers to make better quality veld hay owing to earlier cutting being made possible when the grass has a higher feeding value, owing to the fact that advantage can be taken of short dry spells during the months of January and February.

A Home-made Ox-drawn Hay Sweep.—This type of hay sweep was illustrated in the *Farmers' Weekly* of 17th February, 1937, and the instructions for making it were given

by Mr. C. J. Littleton and are quoted below. This gentleman states that it is commonly used in Scotland and Northern England, where it is called a "Tumbling Paddy." Mr. A. Stidolph, farming near Salisbury, has had one of these sweeps made locally, and has found it of the greatest assistance in his hay making this year.

With two oxen and four natives it collected 36 acres of a good crop of veld hay into cocks in two and a half days.

Since this sweep can be made on any farm it may appeal to many farmers, and Mr. Littleton's instructions for making it are as follows. (See illustration.)

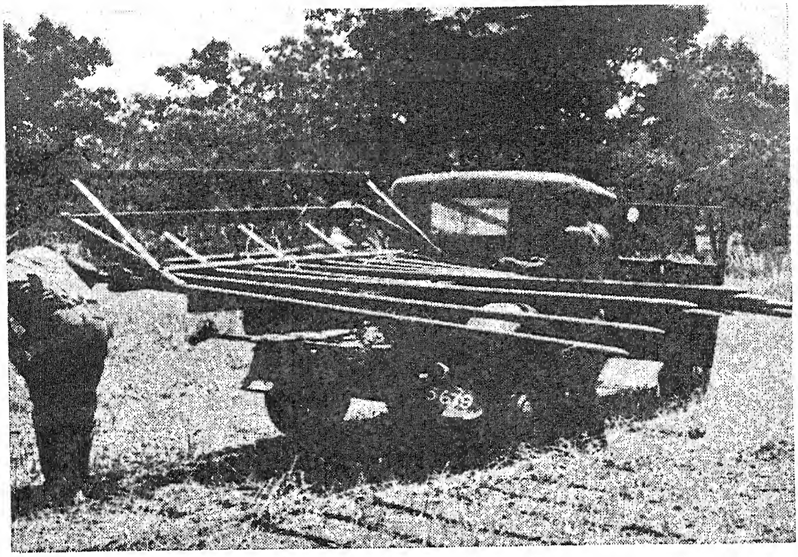
"It is made of a stout plank 10 feet or 12 feet long and 9 inches wide in the centre, tapering to 4 inches at each end, with 6 wooden teeth; the two centre ones 4 ft. 6 ins. and the outside ones 3 feet long. These are pointed and shaped as shown, so as to keep them from running into the ground. There are two handles of a half moon shape with a light chain from each handle to the end of the plank to steady the load when full.

The draught is from the ends where the light chains are attached, swivel fashion, and brought to a point where the trek chain is hooked on. The chains must be fairly long to allow for the hay banking up on the sweep, and to allow the latter to turn head over heels when emptying the load.

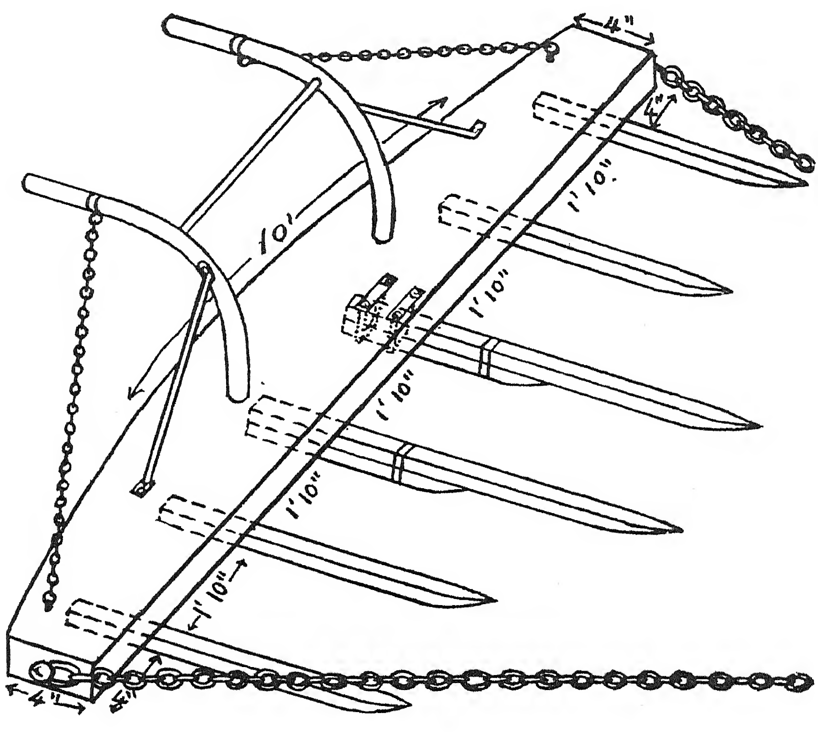
The teeth are fastened to the plank, as indicated, by means of U-bolts. The two centre teeth are provided with short runners underneath to take the wear, such a sweep will hold approximately half a ton of hay.

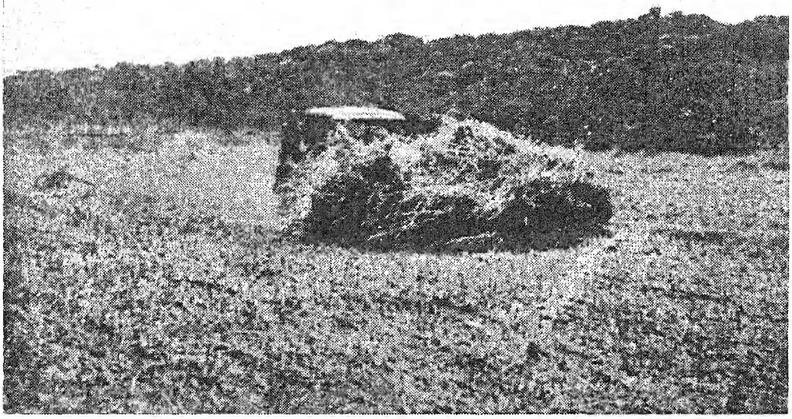
To empty the load the team is stopped and backed and the sweep is pulled back about three feet, the handles are then lifted up to stick the teeth in the ground, and the oxen are driven on, and the sweep turns over dropping its load."

Composting the Sunnhemp Crop.—Either of the above sweeps will greatly economise the time and labour needed in collecting the grass, sunnhemp and other raw materials for composting or for turning into kraal manure, and for those farmers who are already doing this or intending to do so, it is suggested that the loading and carting of the sunnhemp

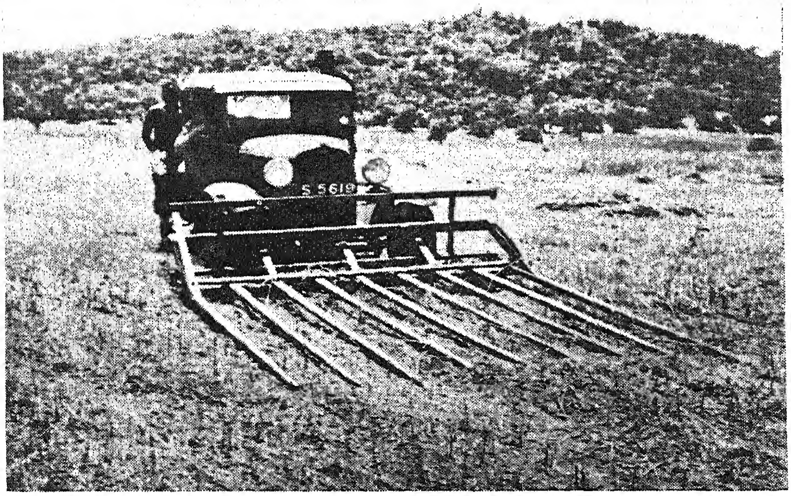


The Sweep is easily removed in a few minutes for transport to another field.
Note shape of points, which are metal-covered.





The Hosier Hay Sweep in action on Mr. A. S. Laurie's farm at Concession. A full load of sunnhemp being pushed to the loading point.



The Hosier Hay Sweep. It is attached to the dumb iron of the lorry.

top growth can be entirely cut out by the making of narrow temporary kraals on the headlands of the fields where the sunnhemp is grown. The sunnhemp can then be mown and swept up to the kraals on either side or at either end of the field, and the only hand labour required is in forking it over into the kraal.

As the kraals are filled to a height of two feet or so with well trampled sunnhemp they can be moved along the headlands. The heaps of sunnhemp, moistened with urine and mixed with dung, can then be handled as compost. If desired maize trash, grass, spoilt hay and other wastes from adjacent fields may be mixed in with it, and the requisite amount of soil and wood ashes or lime should, of course, be applied as advised in the articles on compost manure published in the February and March, 1936, issues of this journal.

Alternatively the kraals can be left in position for a longer period, and the sunnhemp converted into kraal manure, when it should be ready for application to the land before the next season's rains. It may be mentioned here that one farmer, who has already done this, found that the sunnhemp was completely rotted in six to eight weeks.

The conversion into kraal manure is, of course, wasteful of animal dung, and owing to the fact that the temperature will not rise to a high level as in composting, the weed seeds present will not be killed.

It may be pointed out that in this system of handling the sunnhemp crop the cattle will also benefit considerably by eating a portion of the sunnhemp.

Yield of Compost from Sunnhemp.—In the article on compost by the writer mentioned above he gave an estimate of the amount of finished compost which might be obtainable from one acre of well grown sunnhemp. In practice at the Agricultural Experiment Station, Salisbury, it has been found that this estimate is very much on the low side, since one acre of a *poorly grown* crop of sunnhemp (about 4 to 5 feet high) yielded 8 tons of compost made according to the prescription advised in that article.

It seems clear, therefore, on this basis that farmers can easily reduce the idle land under a green manure crop of sunnhemp by considerably more than 50 per cent. by composting the sunnhemp crop instead of ploughing it in. In other words, if a farmer normally ploughs in 200 acres of sunnhemp each year he need only sow 100 acres or less if he composts the top growth therefrom and applies it to another 100 or more acres of his land, which requires organic manure. Of course, when he commences this system he will have to wait a year before the compost will be ready. He can, however, get over this difficulty by sowing the whole 200 acres the first year and composting half of this. Thereafter he need only sow half the area of sunnhemp or less and will have the crops grown on the other 100 acres, which is dressed with compost, as clear profit.

The sunnhemp stubble, after removal of the top growth for composting, should not be ploughed until the cessation of the seasonal rains in order to avoid the loss of available nitrogen by leaching.

There are other advantages which the farmer should reap from this system. Since he will be able to plough the land when it is in perfect condition he will avoid the damage to the tilth of the soil, which is so often forced on him when he is faced with a sunnhemp crop which has reached or passed the proper stage of growth for ploughing in, and a wet and sticky soil.

A further important advantage he should obtain is the elimination of the second ploughing of green-manured land, which is so hard on the oxen, and so costly. The proper ploughing of a sunnhemp stubble and under proper weather conditions can be assured in one operation. This is seldom the case where a heavy top-growth is ploughed under.

Furthermore, the wide variation in results of green-manuring due to the variation in climatic conditions following the ploughing in of the green-manure crop, and prior to the germination of the succeeding crop is very largely avoided. The farmer can depend on the effect of the stubble from year to year, providing he does not disturb it until the soil is nearly dry, after the finish of the seasonal rains.

Reduction of Soil in Compost.—The writer has found that the proportion of soil required in making rain-watered Indore compost as laid down in the article on this subject published in the February, 1936, issue of this journal, when working with the red dolerite soil of the Salisbury district, can be greatly reduced.

He has found that the proportion of soil can be reduced by 50 per cent. without affecting the rate of rotting down and he is of the opinion that an even greater reduction can be made without interfering with the process of rotting. It will probably be necessary, however, to increase the proportion of wood ashes or lime added to the mixture.

The soil is required in the mixture for the following reasons:—

(1) To supply bases such as lime to neutralise acidity and maintain the reaction of the process near neutrality, and for the temporary absorption of ammonia.

(2) To supply clay to form a colloidal film on the surface of the waste materials, which assists the fungi to rapidly commence their action, and also to assist in temporarily absorbing the ammonia.

(3) To supply the necessary fungi and bacteria.

Where the soil is known to be definitely acid, the proportion of wood ashes or lime should be increased, and that of the soil reduced to the minimum found by trial to be necessary.

In Kenya Colony it has been found that it is definitely advantageous to reduce the proportion of soil to a minimum when working with acid soils,* and it is advised.

Since the added soil in Indore compost represents about 50 per cent. by weight of the materials used, it will be clear that if we can reduce this proportion materially we shall be able to make a considerable reduction in the costs of labour for collecting and handling the compost.

It will be obvious, no doubt, that a reduction in the proportion of soil in the mixture will give a parallel increase in the proportion of organic matter or humus in the finished

*East African Agricultural Journal, April, 1937.

compost, and it is for this humus content that compost is chiefly valued. It will be possible, therefore, to reduce the rate of application to the land.

It is thought that where the proportion of soil has been reduced by 50 per cent. that dressings of compost at the rate of three to five tons per acre should be suitable and economic for the maize crop on the red and chocolate clay loams of the Colony.

Turning the Heaps.—Mr. E. B. Etheridge, of Hartley, who is making compost on a considerable scale, has found that at the second and third turns of his heaps a dam scraper greatly economises the labour of turning. At the first turn it cannot be employed, but after rotting is partly advanced, he turns his heap with this implement and re-makes the heaps by hand.

It is probable that a modification of the home-made hay sweep described above might also be used for the same purpose.

REPORT ON THE BRANCH OF CHEMISTRY,

FOR THE YEAR ENDING 31st DECEMBER, 1936.

By A. D. HUSBAND, F.I.C., Chief Chemist.

As in previous years, the major indoor activities of the Branch of Chemistry have been confined to the accomplishment of the routine analytical work coming within the sphere of the agricultural chemist. During the year under review this work has been particularly heavy, the number of samples submitted and analysed, as will be seen from the summarised list below, being higher than ever before in the history of the Branch. Notwithstanding this, however, certain small but valuable items of research were engaged upon, although, owing to the absence of the Chief Chemist on leave and on duty for seven months of the year, and the consequent relegation of his administrative duties to his senior assistant, the remaining staff were unable to engage in research work on any extensive scale.

The routine duties fall under the following heads:—

1. Analyses of soils, manures, agricultural limes, waters for agricultural purposes, and general agricultural products.
2. Analyses of samples taken under the "Fertilisers, Farm Foods, Seeds and Pests Remedies Ordinance."
3. Cattle dips and toxicological analyses for the Veterinary Department.
4. Analyses of samples and standardisation of glassware under the "Dairy Produce Act, 1925" and the "Dairy Industry Control Act, 1931."
5. Cleaning and treatment of tobacco seeds.
6. Preparation of standard iodine and sodium hydrate solutions for control purposes.
7. Advisory work by correspondence and interview.

Summary of Routine Samples.—The following comprises the samples analysed, examined, or otherwise handled, during the year:—

Soils, other than Research	299
Manures and Fertilisers (including wood ashes)	84
Farm Foods	50
Toxicological, other than Investigational... ...	336
Waters	19
Vegetable Products	173
Dairy Products	2
Insecticides	4
Tobacco seed samples	118
Miscellaneous	46
Samples analysed for Rhodes Matopos Estate	155
Investigational Work	269
	1,555

Further, 240 litres of standard iodine for dip testing were prepared and delivered to the Veterinary Department for the use of Cattle Inspectors throughout the country, and 140 litres of standard caustic soda were issued to the Chief Dairy Officer for transmission to dairy farmers for use in acidity tests on certain dairy products.

Soils other than Research Samples.—Two hundred and ninety-nine of these have been analysed and advisory reports issued to the senders. As in former years, the majority were from maize or tobacco lands, the latter being exclusively intended for the flue-cured type. More interest is now being taken throughout the country in wheat production, reflected in the fact that fifteen samples were received from prospective wheat producers. Requests for advice on general crops, apart from the above-mentioned, were common, and thirteen samples came per the Native Land Board from land in the Mukuni Division, Umtali District, with a request for opinion as to suitability for use under irrigation in a projected irrigation scheme from the Sabi River. Analysis showed them to be definitely unsuitable, and a report to this effect was submitted.

A soil reconnaissance of the land proposed to be settled under the Umgusa Irrigation Scheme was carried out by Mr. Ellis, Assistant Chemist of this Branch, during parts of August and September, and his report, embodying the results of chemical and physical analyses of between thirty and forty samples, with conclusions and recommendations, was forwarded to the Secretary for Agriculture in early November. The conclusions were, in general, favourable, but the report stressed the point that "the Mopani veld, which occupies roughly a third of the area of the farm Helenvale J., is the limiting factor in the success or otherwise of the irrigation scheme." The dangers of running the main furrow line or its subsidiary channels through this area were indicated, and it was recommended that either the furrows should be diverted to avoid the dangerous areas, or that they should be lined with cement during their passage through them. Certain sections of soil below the furrow were found to be infertile, and clear recommendations were given as to treatment. Several general recommendations were also given.

The total nitrogen in 55 soils was determined for the Manager, Agricultural Experiment Station, in connection with an experiment on the time of planting sunnhemp. The crop was planted at weekly intervals and ploughed under in each case three months after planting.

Manures and Fertilisers.—Under the "Fertilisers, Farm Foods, Seeds and Pests Remedies Ordinance" 47 fertiliser samples from different vendors were analysed throughout the year, and it is pleasing to report that every one was found to conform to its guaranteed composition.

Eleven samples of wood ash were analysed for the Chief Forest Officer, who wished to ascertain the percentages of nitrogen, phosphoric oxide, and potash from wood ash carefully made and unexposed to leaching, with the object of ascertaining whether the value of wood ash as a fertiliser was sufficient to warrant its production for this purpose.

It was found that the potash figures were exceedingly high compared with all previous samples of wood ash analysed here. The lime and phosphoric oxide figures were practically the same as usual.

The reason for the high potash results was undoubtedly that the samples were uncontaminated, and that no leaching by water had taken place.

The average value as a fertiliser of a sample of wood ash prepared in this way worked out at approximately £4 per ton. The amount of wood ash obtained from the actual wood, however, was in this case only about $\frac{1}{2}$%, so that it is not an economic proposition to burn wood primarily for the purpose of fertiliser.

Fifteen samples of common fertiliser mixtures were analysed qualitatively for the Tobacco Research Station, Trelawney, to ascertain whether certain minor elements were present, particularly boron, mangenese, copper and zinc. Of these, only manganese was found.

Farm Foods.—Four of the forty-five samples under this head were sampled under the Ordinance, and were found to conform to guarantee. Two samples, one of blood meal and one of meat meal, were sent to us by the Medical Officer of Health, Salisbury Abattoirs. Very serious complaints had been received from the purchasers of these, particularly of the blood meal, and a thorough investigation was requested. Analysis of the blood meal gave a moisture content of 45%, which indicated the cause of trouble immediately, and would account for the odoriferous fumes, reek of ammonia and general stickiness complained of. A personal visit was made to the Abattoirs and a report submitted to the Medical Officer of Health pointing out manifest defects in the plant and suggesting several improvements which might be effected.

The fault in the meat meal was excessive fat, due to insufficient pressure being applied to the raw material. This was traced to inefficiency of the boiler which was incapable of giving the pressure stipulated by the manufacturers of the fat extraction apparatus.

No other sample calls for special mention.

Toxicological.—The huge figure of 336 for the number of samples dealt with under this head is higher than that for the total of the preceding three years. It is true that 112 of these represent work carried out on a special investigation in the Umtali area, which will be referred to later, but, even

then, the balance is more than double the total ordinary samples for any previous year in the history of this Branch. Over two hundred were samples mainly submitted by officers of the Veterinary Department for diagnostic purposes, and, of these, three-quarters were found to contain arsenic in dangerous amount. There are only nine dips in the total, and two cases of suspected cyanide poisoning, both of which were found to be negative.

I am unable to give any reason for the abnormal number of cases of actual or suspected arsenical poisoning among stock, and can only reiterate what I have expressed in nearly every one of my previous annual reports, that carelessness in handling dips, or in supervision of their use, is plainly evident, and that deaths of animals due to this cause could, if proper care and attention were paid to the handling of arsenical preparations, be greatly lessened.

A special investigation in the Umtali district, accounting for the 112 samples referred to above, was carried out mainly by this Branch in the earlier part of the year. Full reports of this have already been submitted to the Secretary, and action has been taken by the Government on the lines recommended.

Waters.—The samples call for no special mention. They were examined for hardness, silt content, suitability for irrigation purposes and for presence of salts attractive to cattle.

Vegetable Products.—These consisted of 142 samples of wheat analysed for the Plant Breeder, Hillside Experimental Station, for moisture and protein, ten tobacco specimens from Trelawney Tobacco Research Station for nicotine content, the remaining 21 being miscellaneous specimens such as silage, hay of various kinds, sugar canes, etc.

Insecticides.—The four insecticide samples were pyrethrum flowers from the Mazoe Citrus Estate for analysis for pyrethrin content. The results varied from 0.73% to 0.96%. These are promising figures for a new venture.

Tobacco Seed Samples.—The cleaning and treating of these seeds against possible disease is not strictly work of a chemical nature, and it is felt that, in order to allow the time to concen-

trate on what are, I consider, more important agricultural problems in which chemistry takes a part, this Branch should be relieved of the duty. Representations on these lines were made this year at the commencement of the cleaning season. and sympathetic consideration was given by the Secretary. It was mutually agreed, however, that in order to avoid any possible disorganisation of another Branch at short notice, this office would carry on the work for the 1936 season. In all, 2,690 ounces of seed passed through this laboratory, the work connected therewith utilising the entire services of one of the staff for a period of almost two months.

Miscellaneous.—Estimations of iron oxide content in local samples of iron ore submitted by farmers proposing to utilise them in cattle licks, accounted for nearly half of these.

Iodine values of back fats of sixteen pig samples were determined for the Chief Animal Husbandry Officer to assist him in an investigation designed for the purpose of improving the quality of home-grown bacon, and several fat estimations of common flies and tsetse flies were performed to assist the Chief Entomologist in the research work he is engaged upon at the moment.

Rhodes Matopos Estate.—A temporary assistant, paid from the funds of this Estate, worked in these laboratories for four months of the year doing analytical work required by the Animal Husbandry Officer in charge of the experimental station here. In all 155 samples, consisting of grasses, hays, farm foods, and a few soils, were analysed fully or partially during the period.

Investigational Work.—(1) *Soil Conservation.*—This Branch collaborated with the Irrigation Division in the earlier part of the year in an investigation on soil conservation at Glenara, near Salisbury, on land kindly loaned for the purpose by Messrs. Newmarch and MacLean. Fifteen samples of eroded soil from the traps and tanks were submitted to complete chemical and mechanical analyses, and the results threw considerable light on the losses of plant food ingredients occurring through soil erosion. The results of these analyses and a discussion of the entire experiment were published by the Chief Irrigation Engineer and the Chief Chemist in the March issue of the *Rhodesia Agricultural Journal.*

(2) *Nitrification Experiments.*—Forty-two samples were investigated under this heading, a full description of the technique of which was described in the last annual report. Unfortunately, owing to various circumstances, the results obtained this year were inconclusive, in some cases contradictory; consequently it was decided to carry out the work afresh during the season 1936-37. This is now in progress.

(3) *Nitrate Content of Soils Green-manured under different conditions.*—Analyses were carried out on certain soils for the Experiment Station, the samples being taken from plots where rate of planting of sunnhemp trials were being carried out. The crop received three different treatments on the various plots, that on one set being ploughed under complete when mature; on a second set the top growth was removed and roots and stubble ploughed under; on the third set the crop was left standing for some months, the top growth then removed and roots and stubble ploughed under.

Samples, 144 in all, were taken each month from these plots and analyses made in order to trace the changes in the quantity of nitric nitrogen under the various conditions throughout the season. Up to the present there are scarcely sufficient results to warrant the drawing of any hard and fast conclusions, but it would appear that, whereas at the end of the growing season (approximately in mid-March) the quantity of nitric nitrogen in all the soils was practically nil, immediately after this the four soils into which had been ploughed the complete plant showed a rapid rise in nitrate content. These plots had received seed at the rate of 20, 40, 60 and 80 lbs. per acre respectively, and it is noteworthy that the nitrate content of the soil which carried the 20 lb. seeding ran very close, throughout the year, to the nitrate content of the soils into which were ploughed immature roots and stubble only. The soils which carried 40, 60 and 80 lbs. seed all showed a higher nitrate content than the 20 lb. soil, but did not show any significant differences amongst themselves. It would appear, therefore, that the optimum rate of seeding lies between 40 and 60 lbs. per acre, and that, to maintain a good nitric nitrogen content throughout the winter season, the complete plant must be ploughed under.

It is worthy of note that the quantity of organic matter ploughed under on the 40, 60 and 80 lb. plots is considerably higher than that on the 20 lb. plot. The differences between the yields on the former three plots are insignificant. These conclusions must be taken as merely tentative and may require to be modified as a result of further work which is at present in progress.

The soil into which the complete plant was ploughed, maintained its lead throughout the season and was followed by the soil which received roots and stubble at the same time. The content of nitric nitrogen in the latter never rose as high as that of the former, but it also maintained its position throughout the season, although there seems now (December) to be a tendency for these two types to approach closer as regards quantity of nitric nitrogen. The third set (crop left standing over some months and mature roots and stubble then ploughed under) showed practically no nitric nitrogen present at all during the winter season. It is intended to carry on these experiments throughout the coming season on a somewhat more extended scale.

(4) *Arsenic in viscera of healthy cattle.*—Suggested by some unexpected results arising in the course of the arsenical problem in the Xmas Pass area, Umtali district, referred to above under the toxicological section, an investigation was designed and carried out to ascertain to what extent arsenic was present in the stomach contents of normal animals slaughtered for food purposes. Samples from twelve different animals were kindly supplied by the Acting Manager, Salisbury Abattoirs, and analysed for arsenic. These animals had been in perfect health and had been slaughtered in the ordinary way for food purposes. From each one a sample of abomasum wall and a sample of stomach contents were obtained. The former was thoroughly washed before analysis, to prevent contamination from the contents. The findings were that eight samples of abomasum showed the presence of arsenic varying from .03 to .33 mgms. per 100 gms. of sample, and 10 stomach contents were positive, with amounts varying from .07 to .04 mgms. per 100 gms. of sample. It is a reasonable assumption to make that the presence of these quantities of arsenic was due to dipping.

It should be noted that the above quantities are extremely small and refer merely to the arsenic contained in the stomach contents and stomach wall. No analyses were made of the other internal organs, but it is highly improbable that more than mere traces, if any, of arsenic would be found in them. Analyses to verify this supposition will be made at a future date.

(5) *Trypanosomiasis Research.*—Further work was done on the soil samples collected by the Beit Research Worker on trypanosomiasis referred to shortly in last year's report.

Summarising and looking at the results from a purely agricultural point of view, the soils, taken from specially selected spots in which pupæ were stated to have been found are, in every respect, more suitable for the development of plant life containing, as they do, considerably more inherent fertility and better physical properties than the soils in which no pupæ were found.

PASTURE RESEARCH STATIONS.

Marandellas.—The season 1936 was a very favourable one for the growth of the grass on this station with the result that the yields of hay were very much greater than in the year 1935.

Although no fertiliser has been applied to any of the paddocks since 1933, the yield of hay from the paddocks previously fertilised is still, with the one exception of the paddock fertilised with raw rock, considerably in excess of the unfertilised paddocks. The paddocks which received sulphate of ammonia in addition to potash and superphosphate have, since the experiments first began, been markedly superior in yields of hay to the fertilised paddocks which received no sulphate of ammonia. The results of fertilisation have therefore demonstrated the superiority of a mixture containing sulphate of ammonia to mixtures containing only potash and phosphorus.

At the commencement of the 1936 season the unfertilised control paddocks were treated with sulphate of ammonia at the rate of 100 lbs. to the acre with the object of determining the influence of a nitrogenous fertiliser alone on the yield and quality of the hay.

During the year under review the yield of hay from these paddocks was more than double that obtained in 1935, and on the others, except raw rock, there was at least a 50% increase. The raw rock paddocks only showed an increase of 100 lbs. per acre, and the yield was slightly lower than the average for the previous five years. The N.P.K. paddocks did not show much increase over the average, but it should be remembered that its average, due to heavy yields obtained in the years the paddocks were fertilised, is much higher than those of the other treatments. The P.K. and super paddocks both show about a 30% increase compared with the average. The control paddocks on the other hand show the remarkable increase over the average yields for the previous five years of 85%—this, it is considered, must be ascribed in part to the season, but mainly to the effect of the ammonium sulphate which has been shown in the past to exercise a marked influence on the growth of the pastures.

The cost of the fertiliser applied amounted to 8s. 9d. per acre, and the actual increase of hay obtained over the average of the previous five years was 578 lbs. Assuming the value of the hay to be £2 per ton, it will be seen that the cost of the fertiliser applied was recovered in the value of the hay obtained during the first year.

Yields of Hay per acre in lbs. from various Paddocks.

Treatment.	Average yield per acre for previous five years.	Yield per acre 1935.	Yield per acre 1936.
N.P.K.	1,302 lbs.	948 lbs.	1,396 lbs.
P.K	992 lbs.	823 lbs.	1,297 lbs.
Super	902 lbs.	667 lbs.	1,275 lbs.
Raw Rock... ...	794 lbs.	658 lbs.	762 lbs.
Control	738 lbs.	523 lbs.	1,316 lbs.*

*Fertilised 1936 with sulphate of ammonia at the rate of 100 lbs. per acre.

Results of Analyses of Hay Samples.—During the year eighteen samples of hay from the various paddocks were analysed and the resultant figures reveal several points of interest. In general the feeding value of the hay was considerably lower than in the year 1935. This may be explained as being due to the rapid growth made in the early part of the

season and the fact that the grass was more mature than usual when cut. Rain fell on 22 days in February and 20 days in March, which made it impossible to commence cutting until towards the end of March, which is a month later than usual. It has been noted in general that in seasons of good rainfall and heavy yields the feeding value of the hay is less than in seasons of lower rainfall and poorer yields. A comparison of the average feeding value of the hay obtained from the old fertilised paddocks with that from the control paddocks show that the former is still superior to the latter. The difference is much less, however, than in former years, indicating that the dressing of sulphate of ammonia applied during the past season to the old control paddocks has influenced the quality of the hay as well as the quantity factor. The following table showing the results for the past three years illustrates the foregoing points clearly.

	Protein %	K_2O %	P_2O_5 %	Cl. %
1934—Fertilised	4.8	1.33	.37	.22
Control	4.4	1.33	.32	.19
1935—Fertilised	5.8	1.81	.43	.27
Control	4.7	1.73	.40	.19
1936—Fertilised	4.1	1.24	.38	.17
Control	3.9	1.23	.30	.15

Experimental Animals.—The experiments laid down in 1934 to determine the influence of the feeding of various mineral salts to the grazing animals are being continued.

The poor quality of the hay during the past season reflected itself in the condition of all the animals on the station whose food was confined to hay alone.

Although the animals in all the groups went down considerably in condition during the dry season, the animals in the N.P.K. group which receive no lick were in a pitiable condition, whereas those in the other groups, although in poorer condition than usual, did not suffer nearly so much as the N.P.K. animals, and rapidly regained weight as soon as new grass became available.

Three cows in the N.P.K. group that went back so badly that it was feared they would not live through the dry season, were taken out of the group on the 24th April and were given

salt licks. One cow received salt alone, another the salt and iron lick, and the third, salt, iron and potash.

None of these animals showed any visible improvement, but all lived through the season. It was extremely noticeable, however, that as soon as new grass was available all three of these cows made rapid gains in weight, and were in markedly superior condition to the remaining animals in the N.P.K. group. The reason that they failed to show any visible improvement during the dry season from the feeding of the salt licks is undoubtedly due to the poor quality of the hay fed. As will be realised from the analyses of the hay given above, it would be impossible for any animal to consume sufficient of it to supply even its minimum requirement of protein and energy for maintenance.

Although an adequate supply of salt to grazing animals in this country may materially affect their appetites and powers of digestion, it cannot, of course, be expected to exercise any marked influence on their general condition, unless the ration fed contains a sufficiency of energy and flesh-forming materials.

It is the practice on the pasture stations to remove the young steers from the various groups as soon as they attain a weight of about 700 lbs. These animals are all put together until they reach a live weight of about 900-1,000 lbs., when they are fed off for export as "chillers."

Ten steers with an average age of 3 years and 10 months, and weighing an average of 1,254 lbs., were sent to the Rhodesian Cold Storage & Export Co., to be slaughtered as "chillers." Nine of these animals were graded as "Imperial" and one as "Standard." These steers were all fed for the last three months prior to slaughter with a daily ration of legume hay, silage and maize meal.

Sheep.—The Merino sheep purchased in 1932 with a loan obtained from the Sheep Experiment Fund, are still doing well. The entire loan has now been repaid from revenue derived from the sale of lambs and wool. The wool clip for 1935, unsorted, and after making all deductions for packing, railage, selling commission, etc., brought in a net return of tenpence per lb. The selling price of the 1936 wool clip is not yet available.

The ewes on the Station have always been in good condition, but the percentage lambing was disappointing, and the young lambs reared were rather slow in growing out. Autumn lambing has generally been practised, and in view of the rather unsatisfactory results it was decided to change over in 1936 to spring lambing. The change has effected a great improvement, and not only has the percentage lambing increased, but the young lambs have made excellent growth and are in every way superior to those previously obtained under the practice of autumn lambing.

Rhodes Grass.—Small scale experiments on the Salisbury Experiment Station and certain trials carried out by individual farmers in conjunction with the African Explosives and Industries, Limited, have demonstrated the usefulness of Rhodes grass under varying climatic and soil conditions in the Colony.

In order to obtain more detailed information regarding this grass, plots were laid down during the past season at the stations at Marandellas and Matopos.

At Marandellas 10 acres of sand veld that had been used the previous season for the growing of cowpeas and soya beans were well ploughed and a good seed bed prepared. The seed was sown at the rate of 10 lbs. to the acre, in the middle of December, 1935, no fertiliser being applied. The seed germinated well, but the young seedlings received a severe setback from 10 days' hot, dry weather that followed just after germination had well begun. Despite this setback the young plants later came on well and a good cover was established by the end of the rainy season. The plants were allowed to seed and from approximately 6 acres 570 lbs. of seed was collected.

The grass was sampled for analysis on the 23rd March, when it was in full flower, and again when it was cut for hay on the 13th April after the seed had been collected.

The results of the analyses are given below, and it will be seen that at the flowering stage the grass had a protein content of 12 per cent., and even at the later stage when the seed had been removed the protein value was 8.6%, which is roughly double that of the ordinary veld hay grown on the station. The mineral content of both samples of the Rhodes grass hay is remarkably high, particularly in the case of the potash and chlorine figures.

It is important to note that this grass was grown on poor granite sand veld without any fertiliser treatment in a year when the ordinary veld hay was of exceptionally inferior quality.

It is true, of course, that the land had been carefully prepared and had previously been planted to a leguminous crop, which had probably increased the nitrogen content of the soil, but even so, the feeding value of the hay was considerably greater than of any ordinary veld hay that has been analysed in this laboratory.

It is also possible that subsequent crops may not be of the same quality as that obtained during the first year after planting.

In the present instance, however, the grass was not cut for hay until long after it had reached maturity, therefore it is hardly probable that future cuttings, if made when the grass is in the flowering stage, will be inferior in quality to that produced under the above conditions.

In view of the favourable result obtained a further 22 acres of this grass have been sown in order that thorough trials may be made to determine its carrying capacity, permanence, yields of hay, etc.

Analysis of Rhodes Grass.

	In full flower. Cut 23/3/36. %	Hay with flower heads removed for for seed. Cut 13/4/36. %
Ash	6.31	7.31
Acid soluble ash	5.36	5.65
Ether extract	1.05	.94
Fibre	41.30	51.47
Nitrogen	1.93	1.38
Crude protein...	12.01	8.61
CaO	.54	.40
K_2O	3.14	3.40
P_2O_5	.54	.44
Cl.	.82	.90

Matopos.—Two acres of the heavy black land on this this station was ploughed and planted to Rhodes grass on the 2nd of January, 1936.

This soil is extremely difficult to work and it was impossible in the time available to produce a satisfactory seed-bed for the seed grass. The seed was, however, sown, but the germination was very poor and many of the seeds that germinated died out in the hot dry spell that followed. A number of good healthy plants were established and these are gradually spreading out over the plot, but as far as the first year's results are concerned the attempt to establish a good cover of Rhodes grass was not successful. It is possible that the poor tilth of the soil was partly responsible for this failure, therefore a further attempt is being made during the present season to establish this grass, greater care being exercised to obtain a suitable seed-bed.

Sunnhemp (*Cotalaria juncea*).—Considerable interest has recently been evinced by farmers in the possibility of feeding sunnhemp to cattle as a substitute for veld hay.

It is known fairly generally that certain species of *crotalaria* are toxic to cattle and sheep, and although a number of farmers in the Colony claim that they have fed sunnhemp successfully to cattle, the fear is expressed in many quarters that such feeding may be harmful. In order to obtain more definite information on this problem, a few acres of sunnhemp were planted on the Stations at Matopos and Marandellas, and small feeding trials carried out with the hay made from the sunnhemp when it was at flowering stage.

Samples of the hay were taken for analysis, and may be compared with the results obtained from sunnhemp grown on the Salisbury Experiment Station. The results are given in the following table, from which it will be seen that of the two samples taken from Matopos one was from the stack of hay as fed to the cattle, the other was taken at the time of mowing and dried under cover. The Marandellas sample was taken from the stack, and the Salisbury one dried under cover. The methods of sampling are reflected in the resultant analyses, from which it is seen that the samples from the stacks have an appreciably lower feeding value than those dried under

cover. This is probably largely due to the loss of leaves in the hay making process, and in part also to the effect of strong sun and a certain amount of rain.

The yield of hay obtained at Matopos was 1½ tons per acre after three and a half months growth. At Salisbury the yield was slightly less (2,700 lbs. per acre), but the crop was cut before it was three months old. The yield was not recorded at Marandellas.

Sunnhemp—1936.

	Matopos.—Taken from stack. Planted 1/1/36. Cut 20/4/36.	Marandellas.—Taken from stack. Planted 1/1/36. Cut 3/4/36.	Matopos.—Dried under cover. Planted 1/1/36. Cut 20/4/36.	Salisbury.—Dried under cover. Planted 5/12/35. Cut 26/2/36.
Lab. No.	597/I.	304/I.	362/I.	153/I.
Moisture	7.93	7.11	6.77	8.83
Ash...	4.59	4.29	4.91	6.66
Acid soluble ash	3.85	4.07	4.50	6.02
Ether extract... ...	.60	.80	1.19	1.44
Fibre	49.6	43.4	37.6	38.1
Crude protein ...	7.92	9.89	14.00	13.87
CaO...	.77	.55	.95	1.06
K_2O...	1.57	1.96	1.91	2.00
P_2O_5...	.22	.34	.37	.33
Cl.	.21	.02	.25	.18

At Marandellas four young steers rising 3 years old were placed in a small paddock and fed the sunnhemp hay *ad lib.* No veld hay or other supplementary food was given beyond the usual salt lick, and water was always accessible. The sunnhemp hay, although rather black and unpalatable in appearance, was very readily eaten by all the animals. The experiment was commenced on the 25th June, 1936, and con-

tinued until the 8th of September, 1936, when the animals were returned to their usual paddocks. Their weights at the commencement and end of the experiment were as follows:—

No.	Weight on 25.6.36.	Weight on 2.9.36.
C 25	780 lbs.	750 lbs.
K 25	855 lbs.	869 lbs.
R 20	923 lbs.	913 lbs.
S 26	828 lbs.	800 lbs.

It will be seen that three of the steers lost slightly in weight during the experiment, but this was to be expected as the hay could not be regarded as anything more than a bare maintenance ration.

It has been found on the Pasture Stations that animals under similar conditions but fed veld hay fall off much more in condition than was the case with the above steers.

The remaining sunnhemp hay was fed to a group of young steers being fattened for export, and in no instance was there any sign that the hay was affecting them adversely.

It was, however, very noticeable that all the animals seemed to prefer the sunnhemp hay to the ordinary veld hay. Similar results to the above were also obtained on the Pasture Station at Matopos. Further feeding trials with this hay will be carried out on both stations during next season.

The results of the preliminary investigations indicate that sunnhemp, if cut for hay during the early flowering stage, may safely, and even with advantage, be used to supplement ordinary veld hay in the feeding of stock.

Soya Beans.—For the past three years very good results have been obtained with the planting of soya beans for hay on the poor sandy soils such as exist on the Marandellas Station. The general growth of the plants was found to be greatly enhanced by inoculation of the seed before planting. The hay is very readily eaten by the stock, and it has been found that a small daily ration given to the young steers on the Station greatly assists them in coming through the long dry season, and prevents to a large extent the falling off in condition which is general among all the animals fed on hay alone during the winter months.

Below is an analysis of the soya bean hay produced at Marandellas during the past season :—

Soya Bean Hay, 1936.

Lab. No.	412/I.
Ash	5.26
Acid soluble ash	3.92
Ether extract	3.06
Fibre	30.20
Nitrogen	2.50
Crude protein	15.65
CaO	.90
K_2O	1.41
P_2O_5	.53
Cl.	Trace.

Pasture Research Station, Matopos.—The rainfall on this Station during the 1936 season was the best that has been recorded during the past five years. The rains were late in setting in, but from the latter part of December until the end of March no long drought periods were experienced. As reported in my Annual Report for the year 1935, the drought years experienced on this Station had seriously affected both the hay and grazing paddocks.

The favourable rainfall during the past season has effected a great improvement in the paddocks and in the yields of hay obtained, but obviously, owing to the drastic manner in which these paddocks had to be grazed during the lean years, it could not be expected that the results of this treatment could be effaced by one good season.

Many of the better types of grasses were almost eliminated during the drought years, and although these increased during the last season the coarser and hardier species at present predominate in all the paddocks. This is reflected both in the yields of hay and in its feeding value, different parts of the same paddock showing wide variations.

Blackland.—During the first two years of the experiments the yield of hay from these paddocks ranged from 1,560 lbs. to 2,022 lbs. per acre. During the three very bad drought years 1932-34, these yields dropped to a range of 407 to 470 lbs. per acre.

In 1935, the rainfall which was good until the 10th February when it ceased altogether, the yields varied from 751 to 1,067 lbs. per acre. During the year under review the yields ranged from 1,022 to 1,490 lbs. per acre, all the paddocks, with the exception of the N.P.K., giving a considerable increased yield over that obtained in 1935. I am of the opinion that these increases are entirely due to climatic conditions and the variations between the yields from the different paddocks are due more to the degree to which they suffered from over-grazing and the effects of the droughts than to the fertiliser treatment that was accorded to them during the first three years of the experiments. The one possible exception is the old control paddock which was fertilised at the beginning of the season with sulphate of ammonia. This paddock gave a 66% increased yield of hay over that obtained in the previous year, and it is probable that the fertiliser application was partly responsible for this large increase. On the other hand, it has to be recognised that the raw rock paddock showed an increased yield during the same year of nearly 100 per cent., although no fertiliser had been applied for three years.

Yields of Hay in lbs. per acre from Blacklands Hay Paddocks.

Treatment.	Average 1930 & 1931.	Average 1932, 1933 & 1934.	Yield 1935.	Yield 1936.
N.P.K.	2,022	439	1,015	1,103
P.K.	1,585	444	1,004	1,490
Super	1,627	407	1,067	1,022
Raw Rock	1,560	435	751	1,463
Control	1,647	470	832	*1,387

*Control paddocks received 100 lbs. per acre sulphate of ammonia in 1936.

Results of Analysis of Hay Samples.—Twenty-one samples of hay were analysed from this station, twelve being from the blackland paddocks and nine from the sandveld.

Blackland.—The beneficial effect of the satisfactory growing season, during which the grass did not receive any serious setback, is readily seen in the feeding value of the hay obtained. The results from the previously fertilised paddocks are very even and are appreciably higher than those obtained in 1935. The analyses of the hay from the control paddocks are also superior to those in 1935, but they are poorer than the 1936 results from the previously fertilised paddocks in spite of the application of sulphate of ammonia.

The possible explanation of the comparatively high feeding value of the hay from these paddocks during the past season may be due to the fact that the favourable rains brought up a large quantity of annual grasses, and the botanical composition of the paddocks was, therefore, very different from the normal.

The following table shows the mean analyses of the hay from the fertilised and control paddocks for 1935 and for 1936.

	Protein. %	K_2O. %	P_2O_5 %
1935—Mean of fertilised ...	4.59	1.21	.27
Mean of control	4.03	.96	.17
1936—Mean of fertilised ...	7.02	1.42	.45
Mean of control*	5.90	1.32	.25

*Control paddock received 100 lbs. per acre of sulphate of ammonia.

Hay Yields, Matopos.—Sandveld.—Compared with the average yield over the previous five years on the various paddocks the yields obtained in 1936 show a very marked increase. This is particularly so in the case of the P.K. paddock which gave the very satisfactory yield, and the highest yet obtained from sandveld, of 1,679 lbs. per acre, as against an average of 665 in the previous five years. The N.P.K. group also showed its highest yield in the six years of the experiment. Both these paddocks showed a definite increase over the yields obtained in 1935. The other paddocks —super, raw rock and control—are closely comparable, and their yields are all respectively about 300 lbs. per acre greater than the five years' average, but at the same time these yields are less than those obtained in 1935. It would therefore seem

that the seasonal factors have not exercised a great influence in these cases, nor can any beneficial results be attributed to the nitrogenous fertilisers applied to the control paddock.

Yields of Hay in lbs. per acre from Sandveld Hay Paddocks.

Treatment.	Average for 5 years 1931-1935.	Yield 1935.	Yield 1936.
N.P.K.	852	1,132	1,396
P.K.	665	1,160	1,679
Super	640	1,079	947
Raw Rock...	621	955	935
Control	538	913	*843

*Control paddocks received 100 lbs. per acre sulphate of ammonia in 1936.

Reference has been made in previous annual reports to the fact that the sandveld section at Matopos appears to be much less adversely affected by drought conditions than the heavy blackland section. In these circumstances it could not be expected that a favourable season would exercise such a marked effect on the hay fields from the sandveld as from the blackland.

It is of interest, that despite the adverse climatic conditions that have prevailed at this station since the experiments first commenced, the yields of hay from all the sandveld paddocks have been considerably greater during the past three years than those obtained in 1931 when the experiments were first laid down and fertiliser was applied.

Not only is this improvement reflected in the yields of hay, but, as will be seen from the analytical data, the quality of the hay has also improved considerably.

Experimental Animals, Matopos.—The animal experimental work at this station has been considerably handicapped owing to the fact that a large proportion of the animals under experiment are in the East Coast fever quarantine area, and cannot be taken to the weighbridge which is situated in the free area.

No weights of these animals are therefore available, and it is impossible in the circumstances to make any reliable pronouncement regarding the influence of the feeding of the various mineral licks to the animals on this station.

Whereas at Marandellas the results of mineral feeding are very obviously apparent, the cattle at Matopos are all in such good condition that any difference there may be between the various groups is not sufficiently apparent to be detected without resort to the weighing machine. As stated in previous reports the animals on this station do not show the same craving for salt as those at Marandellas.

The licks, and particularly the one containing potash, are now readily taken by the Matopos animals, but the controls, which receive no lick, do not show any signs of unnatural craving, neither is their condition, even during the dry season, visibly inferior to that of the animals regularly receiving licks.

During the year 15 steers, all under four years of age, were fattened and sold to the Rhodesian Cold Storage & Export Co., Ltd., for slaughter as "chillers." Eleven of these animals were graded as "Imperial" and four as "Standard."

It is of interest to note here that when the Pasture Stations were first laid down the young animals born at Matopos grew out much more quickly than those at Marandellas, and the steers at the former station were ready for fattening for slaughter very much earlier.

During the past year the steers sold from Marandellas had all received salt licks either from birth or early in life. These animals were ready for slaughter equally as early as the Matopos steers, and were, in fact, slightly heavier in weight, demanded a better price, and were graded rather higher at the Cold Storage Works than the Matopos animals. This improvement in the Marandellas animals is even more marked in the young steers that will be prepared for slaughter during the next few months. These animals on the veld alone are already nearly a 1,000 lbs. in weight at an approximate age of three years.

Revenue.—The revenue from the Branch for the year ending 31st December, 1936, was as follows:—

Pasture Research Stations	£272	1	9
Services of Agricultural Chemists... ...	118	14	5

Travelling.—Twelve visits of inspection were made to the Pasture Research Station, Marandellas, and five to the Matopos Station.

The Xmas Pass area, Umtali district, was visited on three occasions in connection with the alleged chronic arsenical poisoning among cattle referred to in the body of the report, and the Acting Chief Chemist accompanied the Chief Animal Husbandry Officer on two of his visits to Argyle Ranch, Beatrice District, to inspect there the cattle lick experiments of the latter.

Publications.—The following were published throughout the year from this Branch in the *Rhodesia Agricultural Journal*:—

(1) Fertilisers, Farm Foods, Seeds and Pests Remedies Ordinance, January issue.

(2) Results from Glenara Soil Conservation Experiment Station, March issue. (In conjunction with the Irrigation Branch.)

(3) Notes on the Optimum Time for ploughing under a green manure crop of Sunnhemp, November issue.

In conclusion, I desire to record my appreciation of the loyal co-operation and efficient service rendered by all officers of the Branch during the year.

NYOUTI or MUNGA

(*PENNISETUM TYPHOIDES*) AS A FEED FOR BACON PIGS.

By C. A. MURRAY and A. E. ROMYN.

Summary.—Two groups of young pigs were used in an experiment to determine the feeding value of nyouti meal for pigs and its effect on the quality of the carcase.

Group 1 received a ration (proportions by weight) consisting of 90 maize meal, 10 meat meal, 1 salt, and Group II. 45 maize meal, 45 nyouti meal, 10 meat meal, 1 salt.

The rations were equally palatable and resulted in similar rates of growth and economy of gain.

The carcases from the two groups were similar. Any slight differences that might have existed being in favour of the nyouti fed pigs.

General.—Nyouti, or munga, is grown extensively by natives in Southern Rhodesia as a grain crop. Large quantities find their way annually through traders on to the European market and farmers can usually purchase or trade this grain at a lower price than maize.

Enquiries as to the suitability of this grain as a feed for pigs and other types of livestock are therefore common, and this experiment is one of a series to obtain information on the feeding value of this grain for pigs and other livestock.

The only work on the feeding of nyouti to pigs that could be traced is reported from the Union of South Africa by Murray, Schutte and du Plessis(1) and reviewed by Schreuder and Murray(2) as follows:—

> "The results of a feeding trial indicate that nyouti may be substituted for barley in a ration consisting of 45 parts by weight of maize meal, 45 parts barley meal and 10 parts meat meal. The pigs on this maize meal, nyouti

meal and meat meal ration made phenomenal gains, averaging well over 1.5 lb. daily. They grew well and showed no tendency to become overfat. The quality of the carcases was excellent.''

The experiment also showed that the maize-nyouti-meat-meal pigs had slightly firmer fat than the maize-meat meal pigs and were equal in these respects to the maize-barley-meat meal pigs.

PLAN OF THE EXPERIMENT.

The experiment was carried out at the Matopo School of Agriculture and Experiment Station, Rhodes Matopos Estate, during the period 17th October, 1933, to 18th March, 1934.

Pigs Used and Rations Fed.—Thirty pure bred Large White and crossbred Tamworth (boar) x Large White pigs were used in the experiment. They were divided into two groups of 15 each. The groups were evently balanced in regard to age, weight, sex and breeding of the pigs.

The two groups received the following rations:—

Group 1.

Maize meal, 90 lbs.
Meat meal, 10 lbs.
Salt, 1 lb.

Group 2.

Maize meal, 45 lbs.
Nyouti meal, 45 lbs.
Meat meal, 10 lbs.
Salt, 1 lb.

Both groups were sty-fed and received their concentrates in the form of a thick slop and were given as much as they would clean up readily twice daily. The pigs had free access to clean drinking water and received small amounts of green feed daily.

Records.—Individual weights of the pigs were taken at bi-weekly intervals and as the pigs reached the correct degree of finish they were railed to the abattoirs of the Rhodesian Export and Cold Storage Co., Ltd., Bulawayo, for slaughter.

The carcases were graded after slaughter and the necessary carcase observations made. Fat samples of each carcase were taken for the determination of the refractive indices according to the method of Hawkins and Ellis(3).

Detailed feed records were kept throughout.

Composition of Nyouti.—Typical analyses of nyouti and maize for comparative purposes are given below:—

Feed.	Water.	Ash.	Crude Protein.	Fat.	Iodine No.	Fibre.	Carbohydrates.
Nyouti . .	9.42	2.18	11.37	4.31	109-115	1.57	71.15%
Maize . . .	7.0	1.3	9.4	4.5	112-116	1.9	75.9%

It will be seen that nyouti is slightly higher (2%) in crude protein than maize. There is practically no difference in fat content. The fat of maize has, if anything, a slightly higher iodine number (112-116) than that of nyouti (109-115), *i.e.*, it might therefore be slightly more softening, but the difference is so small as to be negligible.

RESULTS.

Growth of Pigs. In table 1 particulars are given of the growth and feed consumption of the two groups of pigs.

Table I.—*Details of Growth and Feed Consumption of Pigs.*

	GROUP I. Maize-Meat Meal.	GROUP II. Maize-Nyouti-Meat Meal.
No. of pigs per group	15	15
Average initial weight, lbs.	62	63
Average marketing weight, lbs.	212	214
Average initial age (days)	92	92
Average age at marketing (days) ...	201	204
Average daily grain in weight, lbs....	1.4	1.4
Average daily consumption of concentrates, lbs.	4.4	4.5
Concentrates consumed per 100 lbs.—gain in live weight, lbs....	325	332

The average initial weights were 62 lbs. and 63 lbs. respectively at the age of 92 days. The pigs in Groups I. and II. reached the correct degree of finish and were despatched to the factory at average weight of 212 lbs. and 214 lbs. respectively.

The average age of the two groups was then 201 and 204 days respectively.

Some farmers would consider that the final weights (212 and 214 lbs.) were too high. It should be pointed out, however, that the pigs were exceptionally long, especially the Tamworth x Large White crosses, and it was necessary to carry them to those weights before they were properly finished. The question of the degree of finish at which bacon pigs should be marketed is an important one. [4]It is not possible to go by weight only in determining whether baconers are finished.

Both groups gained 1.4 lbs. daily. Groups I. and II. consumed 4.4 and 4.5 lbs. of meal per pig per day respectively, and it required 325 and 332 lbs. of concentrates respectively to produce 100 lbs. of gain in live weight.

From a growth point of view it can be said that there was no difference between the two rations.

Table II.—*Carcase Measurements and Grades.*

			GROUP I. Maize-Meat Meal.	GROUP II. Maize-Nyouti-Meat Meal.
Average length of side		ins.	30.5	30.5
Plumpness of ham			70% v. good. 30% good.	60% v. good 40% good.
Thickness of backfat:	Nape	ins.	1.2	1.1
	Shoulder	ins.	2.2	2.0
	Back	ins.	1.2	1.2
	Ham	ins.	1.5	1.4
	Average		1.5	1.4
Average Refractive Index of backfat at 40°C			1.4595	1.4595
Grading of Carcases:	Prime	%	70	90
	Medium	%	30	10
	Short	%	—	—
	Inferior	%	—	—

Carcase particulars are set out in Table II. There was no difference between the two groups as regards length of side.

In development of the hams there was also no difference. There were 70% very good and 30% good in Group I., and 60% very good and 40% good in Group II.

The backfat in Group I. on the average of four measurements were slightly thicker than that of Group II. The difference was too small to be significant. The average refractive index of both groups was 1.4595, which indicates that both groups of pigs were equally firm.

The grading of both groups of carcases was very satisfactory and the nyouti fed group graded a slightly higher percentage of prime carcases than the maize group.

A detailed study of the carcases shows, therefore, that there was practically no difference between the two groups and any small differences that might exist are in favour of the nyouti fed pigs.

Conclusion.—From the results of the experiment it is concluded that from a growth point of view the two rations were equally efficient and that 1 lb. of nyouti meal successfully replaced 1 lb. of maize meal in a ration consisting of equal parts of nyouti and maize meal.

There were no differences between the two groups in regard to length of side, ham development and thickness of belly or firmness of the fat. The nyouti fed group had slightly thinner backfat and graded slightly better, but the differences were too small to be significant.

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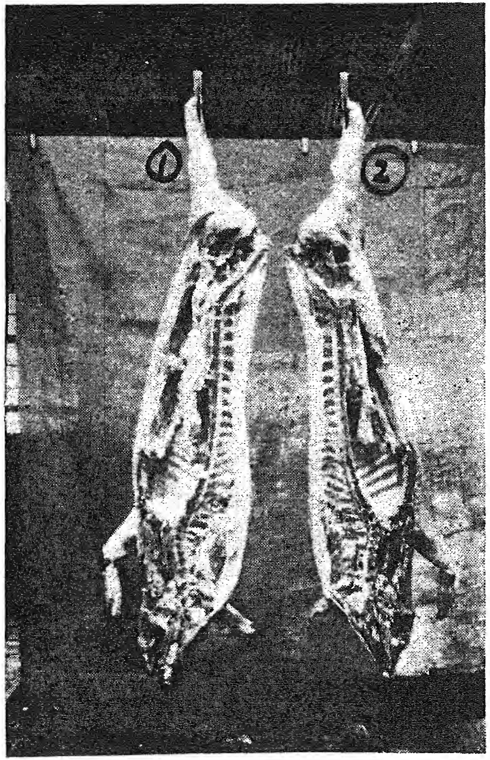
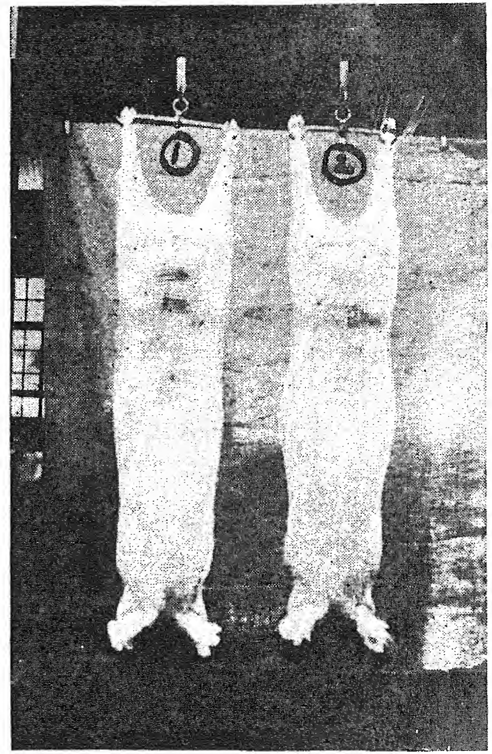
(3)Hawkins, O. G.; and Ellis, N. R. (1926).—Some Results of Soft Pork Investigations.—*U.S. Dept. Agric.* Bul. No. 1407.

(4)The effect of feed on the firmness and grading of bacon carcases.—Division of Animal Husbandry. See separate article in this issue.



Typical sides from Groups 1 and 2 respectively.



Typical carcase from Groups 1 and 2 respectively.

Some Variations in the Food Value of Grain.

By D. C. Crawford, Senior Chemist, Union of S.A. Department of Agriculture and Forests.

The seeds of plants generally constitute a most important addition to the food of animals and men. In the seed coats and around the embryo of the seeds there is a store of protein, starch and oil, intended to supply the materials required for growth during the germination of the seed. The plant compounds thus stored up represent the highest type of vegetable food, whether we consider their concentration, their palatability or their nutritive value. These compounds are also stored in such a form that, with ordinary care, they can be retained indefinitely without loss.

When newly-harvested grain is stored in bulk, however, it sometimes happens that it heats and becomes mouldy. This is due to fermentation set up by the high water content of the fresh grain, and is the cause of serious losses.

It is therefore most important that grain should be thoroughly dry before threshing. During any damp period it is also most important to let the grain become thoroughly dry before it is stored in bulk. In addition to the changes in moisture content, the value of grain and seeds as food is influenced greatly by the degree of ripeness at the time of harvesting.

In the early part of the growing period the materials that pass to a growing seed through the plant sap contain more nitrogenous and mineral matter and less starch than they do in the later stages of growth.

In a sample of maize analysed, it was found that on 20th December the grain contained 19.9 per cent. crude protein; on 8th February, 14.8 per cent.; and when ripe, 11 per cent.

The carbohydrate part of the grain is also subject to great variation during the formation and ripening of the seed.

In the young grain, *i.e.*, in the milk stage of growth, 7.3 per cent. cane sugar, 6.4 per cent. glucose and laevulose, and 51.3 per cent. starch were found. In the ripe grain, on the other hand, the sugars were found to be absent while the starch percentage had increased to 71.2 per cent. Therefore, in addition to the continuous movement of substances to the ripening seed, chemical changes also take place both in the protein and non-protein ingredients of the seed.

When the normal ripening of the seed is retarted or prevented, the grains are not only small but also have the properties of more or less unripe grains, and their food value is much lower than that of normally ripened grain. Thus, a badly ripened kaffir corn grain obtained from a crop which had been damaged by hail gave 12.3 per cent crude protein, 68.7 per cent. carbohydrates, 2.6 per cent. oil, and 2.8 per cent. fibre, as against 10.3 per cent crude protein, 72.1 per cent. carbohydrates, 3.4 per cent. oil, and 1.9 per cent. fibre in normally ripened grain.

In addition to variations in the grain owing to time and condition of the crop at harvesting, we have also considerable changes in the quality of the grain as a result of soil and manuring. Where the crop has been sown thinly, the plants are stronger, and with thin sowing we usually get grain which is richer in protein and starch but poorer in oil than with thick sowing. Heavy soils and manuring with nitrogenous manures usually give grain of higher protein content.

In the case of a malting barley on a plot which had received no treatment the protein content was 8.9 per cent., while on a plot manured with nitrate of soda it was 10.8 per cent.

In a dry year the grain obtained from a light soil may be richer in protein than that obtained from a heavy soil which retains water better. Even when the season has been quite normal, we still find that some grains are small and others large, and that there is a considerable variation in the composition, as well as in the size, of the grain from these two soil types.

It can therefore be seen that there may be considerable variation in the food value of different grain samples, depending on the treatment they have had during growth and ripening.—*Weekly Press Service, Union of S.A. Dept. of Agr. and Forestry.*

Coryza or "Colds" in Poultry.

By T. G. Hungerford, B.V.Sc., H.D.A.

(N.S.W. *Agricultural Gazette*, March, 1937.)

Perhaps the commonest ailment affecting pullets and cockerels is the condition known as coryza. This disease is, and probably always has been, widespread, though in certain localities it is far more common than in others.

Very frequently the disease makes its appearance in January or February, and the birds continue to show symptoms for about three months. During this time very few, if any, deaths can be attributed to the disease, but it causes ill-health, lowered resistance to other diseases and parasitic infestations, and lowered egg production. A similar catarrhal condition is reported from all poultry-raising countries of the world, but it is only in recent years that scientific investigators have made a careful investigation of the disease.

Extensive work has been done overseas to investigate the causal agent. It has been shown that a bacterium known as *Haemophilus gallinarum* is responsible for a catarrhal disease commonly known as "colds" in several countries. It has also been shown that another micro-organism (virus), too small to be seen under the microscope, is the cause of similar catarrhal condition. This micro-organism, like that which causes infectious catarrh and infectious laryngo-tracheitis, though too small to be seen under the microscope, can pass through special filters which hold back bacteria. It has been shown to be quite different from the virus which causes infectious laryngo-tracheitis. Thus, to speak in poultrymen's language, though the condition "colds" has been very well known in all countries for many years, there is still some argument as to the exact causes of the different types of this common disease. It is known definitely to be different from laryngo-tracheitis, but it may have some relation to the other condition sometimes known as infectious catarrh.

Contributing Factors.—Without the causal micro-organism, the disease cannot develop. However, the micro-organism is very widespread, and it will, therefore, be seen that other factors, apart from its presence or absence, must play a part in determining whether an outbreak of this disease occurs. Of these factors, the following may be mentioned:—

Overcrowding.—This would appear to be by far the most important fault in management which pre-disposes birds to this disease. Where pullets are grossly overcrowded it is rare for them to escape a fairly heavy attack of "colds." When affected birds are taken from an overcrowded house and made to roost out in trees, recovery is at times very rapid, particularly where no other factors than the infection and overcrowding are involved.

It is, therefore, of utmost importance to have sufficient houses for the birds to spread out nicely when roosting, and it is an added advantage to have a number of small houses rather than one large one in which birds can crowd in one end.

Green Feed Deficiency.—A deficiency of vitamin A, which is supplied by green feed, cod liver oil or other such like products, markedly lowers a bird's resistance to all catarrhal infections, and a careful watch should be maintained on this point. If at any time green feed becomes short, cod liver oil of a good quality should be mixed freshly with the morning mash, up to 1½ pints per 100 lbs. of mash being given if no green feed is available.

Parasitic Infestations.—Internal parasites, particularly large round worm and tapeworms, are the most important, but external parasitism (lice and red mite) may play a large part in lowering the bird's disease resistance by causing irritation and loss of sleep or loss of blood in the case of the red mite.

Other factors, such as faulty feeding, faulty management, *e.g.*, frequently dosing with Epsom salts with the misguided idea of "purifying the blood stream," may all play their part in lowering the bird's disease resistance. Dusty yards and houses may also be a factor.

Symptoms.—A typical case presents the following appearance:—

The bird looks "off colour," mopes about, sneezes, has a thin mucoid discharge from the nostrils and eyes. After a time this becomes more sticky, cakes around the nostrils together with dust, and also glues up the eyelids so that the bird cannot open them. At night time coughing is much more common, the birds frequently blowing bubbles and sneezing, after which they wipe their noses on the middle of their own backs or on their neighbour.

In most cases cheesy deposits (canker) do not develop. On the contrary, cheesy deposits are one of the typical symptoms of both infectious catarrh and chronic infectious laryngo-tracheitis, the symptoms in this latter disease commonly being called "canker roup" and "diphtheritic roup." In some exceptional cases other germs, probably picked up from dust in the air, start to grow on the mucous membranes weakened by the coryza infection, and these other organisms cause an inflammation, the result of which is a cheesy deposit in the nose, mouth, throat or larynx. As a rule (apart from the few exceptional cases), even where the disease runs its course in a flock for as long a period as three months, causing constant coughing, nasal and eye discharges, these cheesy lesions do not develop.

Owing to the glueing up of the eyes with the thin mucoid discharge, the condition often receives the name "roup."

Of itself coryza probably never ends fatally, but it will be readily understood that while the bird is in a weakened state of health, a heavy worm infestation may be picked up, and this or some other supervening disease may kill the bird.

Treatment.—Any treatment which helps to keep the eyes open will be of some value. In this regard the following eye lotions are suitable:—Argyrol, 15 per cent., or Potargol (colloidal silver preparations), 5 per cent., or zinc sulphate $2\frac{1}{2}$ per cent. (*i.e.*, $\frac{1}{2}$ oz. zinc sulphate to one pint of water).

Such materials as eucalyptus or even kerosene when smeared around the nostrils may act as expectorants, *i.e.*, they aid the mucous secretions. It is held by some that they assist in the course of the disease, but there is some doubt about this.

Many owners claim great success from giving Douglas Mixture in the drinking water, and others from the use of a very weak solution of copper sulphate in the drinking water, while others claim that the feeding of chopped-up onion in the mash is a cure. There is no reliable evidence that these practices are of material benefit when a correct ration balanced in all respects is used. No harm can arise from their use as usually employed, *e.g.*, when copper sulphate is used, usually 8 ozs. are dissolved in 1 gallon of water, and one tablespoonful of this solution is placed in each gallon of drinking water.

Various proprietary remedies are on the market, some of which make extravagant claims as to their value for clearing up this condition. There is no basis for such claims, but some drugs which act as general diffusable stimulants and expectorants may hasten the course of the disease, and their use, therefore, may be economical as long as fanciful prices are not charged for these preparations.

Conclusion.—To review the disease from the practical poultry farming standpoint, serious mortality never occurs, but the disease is a most annoying and costly menace to a large number of poultry farmers. The only practical method of dealing with the disease is by avoiding errors of feeding or management, and, if the disease occurs, careful nightly examination should be made during the first fortnight, and every bird coughing should be removed to a separate pen. Ample green feed should be fed, and, if a worm infestation is present, this should be rectified at once by dosing with a reliable worm medicine.

Successful Control of Witchweed.

BY RHODESIAN FARMERS.

(*Concluded.*)

REPORTS Nos. 16 and 17.

By Mr. George Gray, Brawlands, Glendale.

Report No. 16, *dated August 4th,* 1936.

The control of witchweed is, in my opinion, one of the most dominant problems confronting maize growers to-day, and if we are to remain on the land, this problem must be considered seriously.

At first I did not fully comprehend the menace of witchweed, but later, fortunately, I realised that it was a parasite which must be kept in check and, if possible, eliminated. I have experimented for several years with this end in view.

I find that witchweed appears about ten weeks after planting the maize crop on this farm. When witchweed appeared, my first methods were to destroy as much as possible by hand cultivation and by trenching the badly infested places fairly deeply. When the witchweed reached the flowering stage, I had it picked out by hand and buried in pits. It was soon apparent to me that it would take more than this to eradicate witchweed, so I tried trap-cropping the badly infested land. On the Agricultural Department's advice I have trap-cropped with Sudan grass successfully, and have also tried amber cane, from which the results were very disappointing.

After trap-cropping badly infested land and planting it under maize the following year I have found that, although witchweed has reappeared, it could quite easily be controlled by hand.

I am now convinced that we will never be able to eradicate witchweed completely, *but we can control it to such an extent that it will do very little damage to our crop yields.* In order to do this, we must make storm drains to prevent re-infestation of the fields from outside. Also the lands should be contour ridged before attempting the trap-cropping.

So far I have found Rhodesian Sudan grass to be the best trap-crop; this coming season, however, I am also going to experiment with munga as a trap crop.

The Department of Agriculture has devoted much time and thought to this subject, and farmers would be well advised to consult them.

(Sgd.) GEORGE GRAY.

Report No. 17, *dated* 27*th April*, 1937.

I am sorry I could not let you have an account of witchweed control for last year, as I did not have the necessary figures; however, the following may be of interest to you.

I started the witchweed campaign in early planted mealies on the 25th January, and completed the eradication of the weed by the 20th April.

Finishing at this early date was due to the drought during March and to the lands being baked hard by the excessive heat.

Going round the lands the first time the witchweed was destroyed by hoeing; after that it was carried off in bags and buried in pits. I am convinced that if maize lands are properly drained and contoured against re-infestation from outside sources, badly infested lands can be controlled by hand cultivation.

My worst infested land this year was 150 acres, which was green-manured last year with sunnhemp.

The costs were as follows:—44 boys, 74 working days, average wage 5d. per day per boy, £67 16s. 8d.; meat, £5 10s.; meal at 8s., £18; total, £91 6s. 8d. The total acreage cleaned, 900 acres, at a cost of 24.35d. per acre.

The hoeing was deep, and *all* witchweed was carried from the lands and buried in pits; however, I intend in future to discontinue deep hand hoeing, as it takes too long and a similar result can be achieved by superficial hoeing.

(Sgd.) George Gray.

Editorial Note.—Few farmers in the Colony have had such a severe struggle against the parasite as Mr. Gray, and his certainty that it can be controlled to the point where it will do little damage to the maize crop should serve to hearten others. The costs given by Mr. Gray are of particular interest, and also his decision to change to superficial hand hoeing which, we think, will reduce his costs considerably.

Southern Rhodesia Weather Bureau.

APRIL, 1937.

Pressure.—Barometic pressure was uniformly below normal over the whole country.

Temperature.—Mean monthly temperature was about normal.

Weather Features.—During the first eight days of the month a weak anticyclonic centre persisted over Transvaal, varying in strength with the passage of highs and lows across the south coast. During this period weak gradients existed over Southern Rhodesia, and dew points were fairly high. Scattered showers or thunder showers fell in various parts.

On the 9th and 10th dew points showed a definite decrease and weather became generally fair. A fairly deep low passed across the south coast on the 9th and 10th, followed by an intense high on the 11th. This brought cool cloudy weather to Southern Rhodesia and some drizzle fell in the south and east.

Pressure fell very rapidly after the high had become central over the interior, but was reinforced on the 15th and 16th. Weather remained cool until the 18th, and a good deal of cloud was reported from the south and south-east.

A deep southerly low developed on the 18th, and a general fall of pressure ensued. Weather became fine, and temperatures moderate.

On the 25th a low formed to the north-west of Southern Rhodesia and dew points increased somewhat. A general rise of pressure occurred the following day, but the distribution on the 26th was rather irregular. By the 27th a fairly intense high with its centre over Natal had formed. Unsettled weather with thunderstorms and hail (see note below) occurred in parts from the 25th to the 27th.

The high brought cold weather to Southern Rhodesia, which persisted until the end of the month.

Rainfall.—The total rainfall for the month was generally less than usual.

Hail.—Hail occurred along a belt from the Matopos through Gwelo and up to the Umvukwes, the majority of the storms occurred on the 26th. The storms on the 25th and 27th fell along the same line and on the 25th several were recorded in Makoni and Umtali districts. Destructive intensities developed in the Matopos, Gwelo district, Lomagundi East and Mazoe West.

The following extract is from a letter received from Mrs. C. E. Fripp, "Sauerdale," Bulawayo:—"A severe hailstorm occurred at "Sauerdale" on 26th April, lasting from 3.45 until 4.55 p.m. The temperature fell from 78° F. to 52° F. Rain measured only .40 inches. Hailstones were piled six inches deep in the garden, where trees were stripped of their leaves and branches broken. At nightfall the hail stones were lying unmelted in the garden and on the slopes of the hills."

This report is from Mr. W. Purcell-Gilpin, of "Bushy Park Ranch," Umvuma:—"On the 26th, when 1.57 inches of rain fell, the trees were denuded of their foliage, some trees were blown down and thousands of fish were killed. The grass was cut as if locusts had eaten it. The hail, where it had drifted, was six to eight inches deep."

APRIL 1937.

Station.	Pressure Millibars, 8.30 a.m.		Temperature in Stevenson Screen °F.								Rel. Hum.	Dew Point	Cloud Amt.	Precipitation.			Altitude (Feet)
			Absolute.		Mean.												
	Mean.	Normal.	Max.	Min.	Max.	Min.	½ Max. Min.	Normal.	Dry Bulb.	Wet Bulb.	%	F.	0-10	Ins.	Normal	No. of Days	
Angus Ranch... ...	...	...	90	54	80.4	60.9	70.7	70.4	68.5	64.1	79	62	...	0.02	1.00	1	...
Beitbridge...	966.3	...	97	49	86.9	61.7	74.3	...	71.8	63.7	64	59	4.1	0.10	0.41	1	1,500
Bindura...	893.1	...	86	50	79.9	59.0	69.4	...	67.2	61.1	71	58	4.3	0.35	1.61	5	3,700
Bulawayo	871.2	871.7	85	43	77.1	54.2	65.7	65.9	63.7	57.4	69	53	4.5	0.08	1.73	2	4,393
Chipinga	894.2	...	85	51	74.0	57.1	65.6	...	65.4	60.5	77	58	4.5	1.12	2.33	8	3,685
Enkeldoorn...	859.1	...	84	47	76.0	53.9	65.0	64.6	63.9	58.0	71	54	3.8	0.40	0.72	1	4,788
Fort Victoria	897.5	897.9	87	47	76.7	54.8	65.7	65.0	65.3	60.2	75	57	4.7	0.13	0.64	2	3,571
Gwaai Siding	905.7	...	91	42	86.1	54.8	70.5	...	67.7	60.3	65	56	2.5	0.56	1.38	2	3,278
Gwanda...	908.3	...	89	41	79.4	56.4	67.9	...	67.4	60.5	68	57	3.7	0.16	0.67	2	3,233
Gwelo	863.8	...	83	46	76.0	54.1	65.1	65.5	62.6	57.3	73	54	4.9	0.78	0.75	2	4,629
Hartley...	886.9	...	87	45	80.4	54.6	67.5	68.0	66.9	60.2	68	56	2.3	0.84	0.87	6	3,879
Inyanga...	838.2	...	82	43	73.0	51.4	62.2	...	64.4	56.8	63	52	2.9	1.23	1.23	7	5,503
Marandellas	839.0	...	81	45	72.3	53.8	63.0	...	61.3	56.6	75	53	3.0	1.53	1.43	7	5,453
Miami	880.0	...	86	52	78.8	58.1	68.4	...	66.8	61.8	75	59	4.9	0.34	1.39	6	4,090
Mount Darwin ...	909.1	...	92	45	82.5	58.5	70.7	..	69.4	63.4	72	60	5.0	0.38	0.52	3	3,179
Mount Nuza	803.0	...	73	39	61.7	48.8	55.2	...	54.1	52.7	91	52	6.9	1.87	5.19	14	6,668
Mtoko	878.6	...	88	48	78.1	58.6	68.4	...	66.9	61.0	72	58	3.8	1.41	0.61	4	4,141
New Year's Gift...	...	...	91	48	80.3	57.6	68.9	...	68.1	63.4	77	61	...	0.60	1.02	5	2,690
Nuanetsi	964.4	...	94	49	84.7	58.0	71.4	...	70.0	64.3	74	62	4.8	0.30	0.62	2	1,581
Plumtree	866.0	...	85	44	77.1	55.3	66.2	...	66.2	57.6	60	52	1.9	0.58	1.15	4	4,549
Que Que	883.3	...	86	46	81.4	55.3	68.3	...	66.3	59.5	67	55	2.9	0.42	0.73	2	3,999
Rusape	863.6	...	83	45	74.9	53.9	64.4	...	62.2	58.3	80	56	3.5	1.29	1.20	6	4,648
Salisbury	857.6	858.0	84	45	76.9	53.9	65.4	65.5	64.3	57.9	69	54	3.9	1.04	1.05	6	4,831
Shabani...	912.3	...	89	46	78.7	57.6	68.1	...	67.8	61.2	69	57	4.2	0.12	0.60	3	3,131
Sinoia	889.7	...	89	46	82.6	55.0	68.8	...	67.9	60.9	67	57	2.2	1.16	0.95	3	3,795
Sipolilo	886.3	...	85	48	77.5	57.7	67.6	...	68.4	61.3	67	57	3.0	1.50	1.19	6	3,876
Stapleford	843.4	...	79	39	68.4	49.9	59.1	...	59.9	56.8	83	55	5.8	1.58	3.82	12	5,304
Umtali...	894.5	894.9	89	50	79.8	57.4	68.6	66.2	67.0	61.5	74	59	5.3	0.49	1.14	6	3,672
Victoria Falls... ...	913.3	...	93	49	87.6	58.5	73.1	...	69.5	62.2	67	58	2.5	0.39	0.59	3	3,009
Wankie	928.3	...	95	55	90.2	64.6	77.4	...	72.2	63.1	60	57	3.2	0.31	0.62	2	2,567

Southern Rhodesia Veterinary Report.

MARCH, 1937.

DISEASES.

No fresh outbreaks of scheduled diseases.

TUBERCULOSIS.

One hundred and fifty-five head of cattle were tested at Lingfield farm, Gwelo, of which three cows showed a reaction and are being isolated pending a further test.

IMPORTATIONS.

From the Union of South Africa.—Horses 5, bull 1.

EXPORTATIONS.

To Nyasaland.—1 bull.

To Portuguese East Africa.—Oxen 28.

EXPORTATIONS—MISCELLANEOUS.

To the United Kingdom in Cold Storage.—Chilled beef quarters, 9,710; frozen boned beef quarters, 2,500; frozen beef quarters, 5,197; frozen veal sides, 2; kidneys, 3,911 lbs.; tongues, 17,899 lbs.; livers, 24,492 lbs.; hearts, 16,716 lbs.; tails, 5,970 lbs.; skirts, 6,417 lbs.; shanks, 8,851 lbs.

Meat Products.—From Liebig's Factory: Corned beef, 183,588 lbs.; beef fat, 10,000 lbs.; bone meal, 70,000 lbs.; tongues, 1,800 lbs.

G. C. HOOPER SHARPE,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-37.

Monthly Report No. 53. April, 1937.

During the month flying swarms of the new generation of the Red Locust (*Nomadacris septemfasciata*, Serv.) have appeared in the north-eastern districts of the Colony, including Lomagundi, Darwin, Mazoe, Mrewa, Mtoko and Inyanga.

These swarms have apparently matured in the low veld of the Zambesi Valley and the Mocambique Company's Territory.

While the swarms appear to be gradually penetrating further into the Colony they do not appear to be making sustained flights in any definite direction.

Considerable damage to native crops is reported in the Mrewa district.

RUPERT W. JACK,
Chief Entomologist.

NOTICE

The Agricultural Journal of S. Rhodesia

is issued by the Department of Agriculture, and can be obtained upon application to the Editor. The Annual Subscription, which must be paid in advance, is 5/-, and payment may be made by any means other than by stamps.

A 10/- note will cover the subscription for two years.

Persons residing outside Southern and Northern Rhodesia may become subscribers by paying 2/- in addition to the subscription, to cover postage.

If payment is made by a cheque drawn on a bank outside Rhodesia, commission must be added.

All cheques and postal notes must be made payable to the Secretary for Agriculture and Lands.

Date..........................19......

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PUBLISHED MONTHLY.

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VOL. XXXIV.] JULY, 1937. [No. 7

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Export of Porkers.—If sufficient support is forthcoming it is intended to export two consignments of frozen porkers of one hundred to one hundred and fifty pigs each at the end of July and at the end of August.

A price of $4\frac{1}{4}$d. per pound live weight Bulawayo will be paid for all porkers delivered at the Rhodesian Export & Cold Storage Company's works, Bulawayo, and passed for export. Any rejects will be sold on the local market in Bulawayo on behalf of the sender, and any railage paid by the Government thereon will be deducted from the proceeds of sale.

The Department of Agriculture will pay railage from Salisbury and intermediate stations to Bulawayo on lots of ten suitable pigs and over. Railage on smaller lots must be paid by senders.

Pigs intended for these consignments should weigh between ninety to one hundred pounds live weight at Bulawayo and should be under five months of age.

Pigs which have been fed on oily or fatty foods will be rejected. Preference will be given to the Large White/Large Black cross.

Any pig breeder interested in these shipments should communicate as soon as possible with the Secretary, Department of Agriculture and Lands, P.O. Box 387, Salisbury. Applications will be dealt with in rotation until the consignments are completed.

Bulawayo Show.—The Bulawayo Agricultural Society's Thirtieth Annual Show is to be held on Friday and Saturday, September 3rd and 4th. The Show will be opened by General the Right Honourable J. C. Smuts, P.C., M.P., C.H., K.C., etc. Good entries for all sections are expected. The Society's Thousand Guinea Gold Trophy for the best bull on the Show will be competed for as usual. A special feature of the Show will be the Ring Events. The Show Ring has been enlarged and Bulawayo Show supporters are looking forward to the displays by the British South Africa Police from Salisbury. Entries for the cattle section close on August 7th and for all other sections on August 14th.

Native Agriculture: Demonstrators.—According to the annual report of the Agriculturist of the Native Department, the work of the native demonstrators during the 1935-36 season was rendered particularly difficult owing to locusts and erratic weather. Notwithstanding these difficulties, however, the fifty-nine demonstrators operated on a total of 2,407 plots, of which nearly 1,700 were in rotation trials. The total

acreage of the demonstrators' plots was 1,867 acres and ten different crops were grown, including maize, peanuts, rapoko, kaffir corn, wheat, beans, munga, cowpeas and rice. The 1,255 acres under maize averaged 11.5 bags per acre, and the best plot gave a yield of 34 bags. Seventy-nine acres of peanuts gave an average of 15.2 bags with 36 on the best plot. The average yield of wheat, on 137 acres, was 3.6 bags, with 6 on the best plot. Rice on 3 acres gave 9.6 bags per acre with 10 bags on the best plot.

The total crops from the 1,867 acres were 19,301 bags, thus averaging 10.3 bags per acre of all crops, while the average yield on native lands where the methods advocated by the demonstrators were not followed was 1.1 bags per acre. In addition to the above 22 plots of cotton were grown which gave an average of 411 lbs. per acre.

Foot and Mouth Disease Research.—The Fifth Progress Report of the Foot and Mouth Research Committee of the Ministry of Agriculture and Fisheries has just been published. It covers a very wide field of enquiry and deals with such questions as:—

(1) Characteristics of the Virus.
(2) Immunity and the determination of Types.
(3) Nutrition of animals in relation to infection.
(4) Means by which the disease may be introduced into Great Britain.
(5) Carriers of the Disease among farm animals.
(6) Means by which the disease is spread.
(7) Infections of small animals and birds.
(8) Methods of dealing with foot and mouth disease abroad.

The report occupies nearly 400 pages and is well illustrated with photographs and charts, and it can be obtained from his Majesty's Stationery Office, Kingsway, London, at 7s. net.

Nutrition in Relation to Foot and Mouth Disease.—During the time that Mr. Ll. E. W. Bevan, M.R.C.V.S., was carrying out research on foot and mouth disease in this country he

recorded the fact that well nourished animals appeared to suffer more severely from foot and mouth disease than did those which were poorly nourished.

It is interesting to note that the Fifth Progress Report of the Foot and Mouth Disease Research Committee, referred to above, confirms this finding and it is stated that it has been proved in experimental work both at Pirbright and elsewhere that large and well-nourished animals show more severe signs of foot and mouth disease than small and ill-nourished individuals.

Using chiefly rats and guinea pigs, Dr. J. T. Edwards found that age, size, diet, or a concurrent infection influences the susceptibility to inoculation. Every young rat and guinea pig that was inoculated with virus however showed no signs of infection or only very slight infection. Old, fully-grown animals were also often difficult to infect.

Experiments with groups of animals fed on different diets showed that half-grown rats which were rapidly gaining in weight on a highly nutritious diet could be infected with a much smaller dose and also took the disease much more severely than those which were not so well fed.

The conclusion drawn from the experiment is in marked contrast to the more frequent and generally accepted view that young, poorly-nourished, and feeble individuals are most susceptible to many infectious diseases.

The report calls attention to the fact that Mr. Bevan points out that in the 1931-32 outbreaks of foot and mouth disease in Southern Rhodesia the symptoms were on the whole very slight and that the disease was difficult to transmit. The study of virus sent from this country to Pirbright, however, showed that the virus was by no means feeble under the conditions in Great Britain, and it is suggested that the mild cases in this country can probably be attributed to the breed of cattle, the conditions prevailing at the time in Rhodesia, and possibly to some extent to the state of nutrition of the cattle at the time.

Foot and Mouth Disease: Spread of Infection.—It seems certain that infection is not always transmitted by the same methods. Direct contact with contaminated materials has

been proved to be efficient in some circumstances, nevertheless experiments made by Lebailly and repeated at Pirbright have shown that susceptible cattle as a rule escape infection when introduced into stalls vacated three or four days before by highly infective bovines. Magnusson also repeated, in Sweden, Lebailly's experiments and found that in such circumstances spread of infection was uncommon and was most likely to occur in cold weather.

In the experiments at Pirbright, after the fourth day from the rupture of the main crop of vesicles, the disease was never transmitted to susceptible animals, although the latter were kept in loose boxes in which the infected donor or donors had been throughout the reaction, or even when the donor was in the same loose box in direct contact with the susceptible cattle. On the other hand the animals were most infective when the vesicles were fully formed and beginning to break. The statement by Lebailly and others that cattle were highly infective during the very early stages of the disease before the vesicles had developed was not confirmed.

Profits in Improved Pastures.—The recent test carried out at Merryville Station, Yass, N.S.W., Australia, to demonstrate the effect of improved pastures on the growth of superfine wools, opens up, says the *Pastoral Review*, distinct possibilities for those interested in the production of relatively light yielding but high count fleeces. The result shows that contrary to a widely-held view that pastures improved by top-dressing coarsen fleece fibres, the difference in spinning quality between the experimental group and the control group fed on natural grasses was not material. Actually the change over from natural to improved pastures caused a variation in wool type from 74/80's to 70/74's, the latter, of course, being from the top-dressed land. So far as colour and handle were concerned, there was no variation whatever. As a set-off against the minor strengthening of fibre, the improved pasture group recorded a pronounced increase in production. The sheep averaged 11.1 lbs. greasy wool, with an estimated clean scoured yield of 62.75 per cent., while the natural pasture group cut 8.92 lb. with a clean scoured yield of 61.4 per cent. That, however, does not tell the whole story, for as against the usual sheep to an acre run on natural feed, the top-dressed area

carried three sheep per acre throughout the twelve months, and for short periods in the spring and summer 20 sheep to the acre. Thus, even if the 20 sheep period is ignored, fine wool production from improved pastures equalled 33.3 lb. per acre, compared with less than 9 lb. off natural feed. The figures are striking, and indicate a possibility of greatly increasing production of fine wool in districts where the incidence of rainfall favours top-dressing. At the outside, supering, with an annual application of up to one cwt., should not cost more than 6s. an acre, and probably would not amount to more than 5s. A hundred per cent. increase in production, and perhaps more, at a cost of 5s. an acre, ought to be worth while.

Horsesickness Inoculation.—Horsesickness vaccine for the inoculation of horses and mules of all ages may now be obtained from the Veterinary Research Department, Salisbury, at a price of 6s. per dose, and owners will be permitted to give the injections themselves.

Applications, accompanied by cash, may be submitted up to the 1st November, 1937, but owners are advised to inoculate their horses as early as possible and thus ensure that sufficient time for the development of a solid immunity may elapse before the natural horsesickness season commences.

The vaccine must be used within eight (8) days of its issue from the Laboratory.

Full directions will be supplied with the vaccine.

Applications will be dealt with strictly in rotation, and any application unaccompanied by cash or received after the 1st November, 1937, will not be considered.

Applications should be addressed to: The Director of Veterinary Research, P.O. Box 657, Salisbury.

Soil Acidity and Crop Growth.—For the last few years a series of very important crop experiments have been carried out on the Virginia Experiment Station at Norfolk. The results are published in Bulletin 91 of that Station. In order

to appreciate the results tabulated it is necessary to know that the modern method of testing soil acidity is that of determining what is called its hydrogen-ion concentration.

When this value, indicated by the symbol pH is 7 the soil is netural; any figure therefore less than 7 indicates its degree of acidity, and any figure above 7 its degree of alkalinity. In the experiments recorded a pH value of less than 5.5 is considered to be strongly acid; pH 5 to 5-6 medium acid, and pH 6 to 6.5 slightly acid. Certain garden crops were found to favour strongly acid soils, *e.g.*, potatoes, sweet potatoes and watermelons. Those which grew best on medium acid soils included beans, cabbage, carrots, cauliflower, cucumbers, egg-plants, parsley, pumpkins, radishes, strawberries and tomatoes. The following did best on slightly acid soils: Asparagus, beetroot, celery, lettuce, onions, peas and spinach.

It is interesting to note the amount of lime which was required to bring soil having a pH value of 4.7 to a higher pH value. Thus 926 lbs. per acre brought the soil to pH 5.3; 2,778 lbs. per acre to pH 6; 4,630 lbs. per acre to pH 6.6, and 7,408 lbs. per acre to pH 7.

Although it was found that potatoes were less troubled by certain diseases when grown in very acid soil, it was found that the maximum yield was not obtained if the pH of the soil was below 5; thus when grown on a soil with pH 4.5 the average yield in bushels per acre was only 169, but when 200 lbs. of lime was added per acre the pH value rose to 5.1 and the average yield per acre to 239 bushels, an increase of 29%.

STAR BUR-WEED.

ACANTHOSPERMUM AUSTRALE, O. KUNTZE.

By CHAS. K. BRAIN, D.Sc., Director of Agriculture.

The appearance of a new weed which is likely to cause considerable trouble in the Colony has recently been reported by the Acting Native Commissioner of Hartley. According to the report submitted to the Chief Native Commissioner it was not known in the Mondoro Reserve four years ago, but it has now taken possession of old lands, in several cases occupying five acres or more.

The plant is one of the group known as Bur-weeds, and since the spiny burrs are arranged in the form of a star it is one of the so-called star bur-weeds. This particular species was found on the roadside in Salisbury some four years ago and later on the Melsetter Commonage, and was determined by Kew as *Acanthospermum australe*, O. Kuntze.

On good soil it reaches a height of 2 feet, but on poorer soil it forms a compact growth from 9-12 inches in height. As pointed out by the Assistant Native Commissioner of Hartley, it is not eaten by stock and the burs, *i.e.*, the spiny seed cases, stick to the hair or wool of all types of stock, even smooth-haired dogs, and are thus carried in all directions.

Its spread in the Mondoro Reserve is looked upon with concern. The specimen submitted to the Chief Native Commissioner was taken from a densely covered patch about five acres in extent. This particular area was previously covered with a thick mat of couch grass, but the weed has now taken possession and excluded all other types of vegetation.

Fig. 1.—A twig of Star Bur-weed, about natural size.

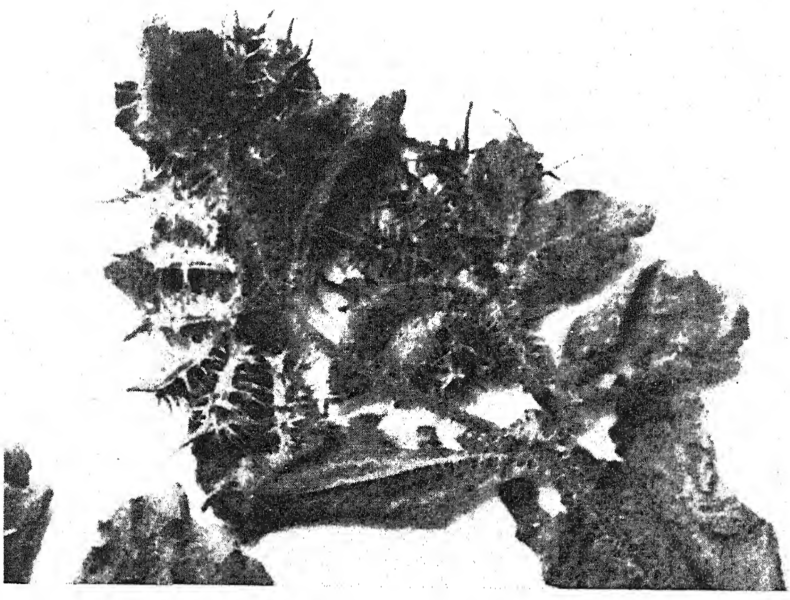


Fig. 2.—Small twig enlarged to show character of the burs.

It will be realised from the above particulars that this weed is a very objectionable one and immediate steps should be taken to eradicate it. If allowed to seed it is almost impossible to avoid its general spread over large areas, and where patches are discovered that have set seed stock should be kept away until the area has been burnt.

The illustration given, which was made from part of the dried material sent from Hartley, will enable farmers and others interested to distinguish the plant and an effort should be made by cutting and pulling to ensure that the plants do not seed in the coming season.

Although this is the first time this plant has been recorded officially to this Department, it is feared that it may be fairly common in some parts of the country and reports of all discoveries will be welcomed.

Preliminary Report on the Feeding of Winter Supplements

TO YOUNG GROWING STEERS AND THE EFFECT OF SUPPLEMENTARY FEEDING ON THE SUBSEQUENT DEVELOPMENT OF THESE ANIMALS.

By C. A. Murray and A. E. Romyn.

Summary.—In this experiment the feeding of ground nut cake to young steers during their first winter after weaning had little effect on their subsequent development, unless the feeding was repeated in the second or third winters.

General.—It is generally accepted that, under conditions where the winter grazing is insufficient for the maintenance and growth of young stock, that the first winter after weaning is the most critical period for the young steer.

In Southern Rhodesia calves on the ranches are usually weaned at the commencement of their second rainy season, *i.e.*, when they they are 9 to 12 months old. Calves born from, say, December to February, are weaned in the following November to January. This gives the calf, when it is weaned, the full benefit from the start of the nutritious young grass and so enables it to continue growing without suffering an immediate setback. Experience has shown that the growth of the calf at this time is usually satisfactory and continues to be so until the grass loses its feeding value at the commencement of the winter, when the calves usually experience a serious setback. The calf at this stage may vary from 12 to 20 months in age.

Practical farmers generally consider that the first winter after weaning is the most critical one as it is the calf's first winter on dry grass without its dam's milk, and moreover it generally cuts the first pair of permanent incisor teeth during this period, which would decrease its ability to graze on hard dry grass.

They have also noticed that losses among yearlings and two-year-olds at this stage are usually particularly heavy during periods of drought or when the veld is over-stocked, and it is quite generally held that by assisting the steer through its first winter it should not only be in better condition at the commencement of the following summer but also that this advantage should be maintained in later life.

Observations by the writers have lead them, however, to think that the importance of supplementary feed during this first winter in relation to feeding during subsequent winters may have been exaggerated and that this kind of feeding may be just as necessary during the second and subsequent winters as during the first one. In order to get further information on this point the present experiment was therefore commenced at the Rhodes Matopo Estate, Bulawayo, during the winter of 1934.

The terms "summer" and "winter" as used in this experiment are arbitrary terms. "Winter" denotes the dry season and "summer" the growing season of the pasture. The dates at which these seasons commence depends on the annual rains, and consequently the lengths of the summer and winter periods vary in the different years covered by this experiment.

Experimental Animals.—Thirty-three uniform yearling ranch-bred weaner steers were used in this experiment and were divided into three similar groups of 11 each (see figure 1).

Rations.—The three groups of steers were fed as follows:—

Group 1.—Control.—Veld grazing only.

Group 2.—Veld grazing throughout the year +1lb. of ground nut cake per head daily during the first winter only.

Group 3.—Veld grazing +1lb. ground nut cake per head daily during the first winter and 1-1½ lbs, daily during the second and third winters.

Management.—The three groups of steers were grazed together. During the summer months the animals received no supplementary feeding. The feeding of the ground nut cake was commenced in Groups 1 and 2 as soon as it was noticed that the steers could no longer maintain their weights on veld

grazing only. Each morning during the feeding periods, except on Sundays, all three groups of animals were collected at the feeding pens in the grazing paddocks and the steers in Groups 2 and 3 were fed individually, according to the plan of the experiment, the correct allowance of ground nut cake in small mangers. (Fig. 2).

Records.—Weight and height measurements of the steers were taken at approximately 28-day intervals throughout the experiment. The method of Eckles was followed in taking these data(1).

Results.—*Growth Data.*—The average live weight and height at the withers of the three groups of steers are given in Table 1 and a summary of these data and a statistical analysis appears in Table 2.

The data given in Table 1 are shown graphically in figures 3 and 4.

The behaviour of the three groups of steers will be discussed separately for the different periods.

It should be pointed out here that it was not intended that the animals in Groups 2 and 3 should make large gains in weight during the winter months. It was planned to feed them on a plane at which they would more or less maintain their weight at the level reached at the end of the previous summer.

Period A.—First "Winter."—It will be seen from Tables 1 and 2 that at the commencement of the experiment the three groups of steers were of the same weight and height. During this first winter period each of the steers in Groups 2 and 3 received 1 lb. of ground nut cake daily while Group 1 received veld grazing only.

The effect of this supplementary feeding of Groups 2 and 3 is well illustrated in figures 3 and 4. From Table 2 it will be seen that the Group 1 steers lost an average of 50 lbs. per animal, which is quite a considerable loss for yearlings. The steers in Groups 2 and 3, however, not only maintained their weights, but actually made small gains of 24 lbs. and 19 lbs. per animal respectively.

(1)Eckles, C. H., 1920.—The Normal Growth of Dairy Cattle. Missouri Agric. Exp. Stat. Bull. 36.

At the end of the first winter Group 2 steers were therefore on the average 75 lbs. and Group 3 steers 70 lbs. heavier than the control animals in Group 1. These differences in weight were obvious even to the layman and are statistically significant (Table 2) that is they are not due to chance but to the extra feed which the animals received.

Group 1 steers looked unthrifty and thin when compared with those in Groups 2 and 3. The animals in Groups 2 and 3 were taller at the withers than those in Group 1, as was obvious from the data in Table 2 and figure 4. The difference in height, however, in favour of the Groups 2 and 3 which had been fed over Group 1 are not large enough to be considered significant. There was no difference in height between Groups 2 and 3 which received the same treatment.

The position at the end of the first winter might be summarised by saying that the two groups which had been fed ground nut cake that winter were 72 lbs. heavier than those which had not received cake.

Period B.—First "Summer."—During this summer all three groups did very well.

Groups 2 and 3 gained 276 lbs. and 267 lbs. respectively. This small difference in weight between these two groups is not significant. The two groups made practically the same gains in height and the small difference in height of 0.4 inches at the end of the summer is not significant.

During this period the steers in Group 1 gained 282 lbs. in weight, and although there is very little difference between the total gains made by the three groups, this summer the difference in weight between Group 1 and Groups 2 and 3 was rather less than at the end of the winter.

Group 1 was expected to do rather better than Groups 2 and 3, as steers not given supplementary feed during the winter months commonly make up some of the loss in this way before the end of next summer. In this case, however,

the steers in Group 1 were still 69 lbs. behind those in Group 2 and 55 lbs. behind those in Group 3 at the end of the summer. These differences are large enough to be significant (table 2). The steers in Groups 2 and 3 were also definitely larger than those in Group 1, as shown by the height measurements. (Table 2.)

> The position at the end of the first summer might be summarised by saying that Group 1 (no ground nut cake) had made up some leeway on the other two groups but it was still 62 lbs. behind the average weight of the other two groups which had been fed ground nut cake during the first winter.

Period C.—Second "Winter."—During the first 28 days of this period the steers in all three groups lost weight. Group 3 was the only group to receive ground nut cake this winter. The feeding of ground nut cake to Group 3 was commenced on the 13th June, 1935.

The winter of 1935 was one of the worst experienced at the Matopos for many years. It was not only an exceptionally long and dry one, but the rains did not commence until late in December, 1935.

The animals in Group 1 lost on an average 205 lbs. in weight during the period, and when the grazing improved they were mere skeletons. In this connection it should be pointed out, however, that all the animals in the experiment scoured very badly after the commencement of the rains in December. During the last month of the "winter" period the steers in Group 1 lost on an average 81 lbs. per head. During this second winter Group 2, which now received no ground nut cake, lost on an average 242 lbs. per animal, of which 100 lbs. was lost during the scouring period. This group, therefore, lost not only more weight than Group 1, but suffered more than Group 1 during the scouring period. At the end of the period the animals in Group 2 were also mere skeletons; in fact, these steers, on account of their larger frames, seemed to show up even worse in comparison with Group 1 than the weight differences would indicate.

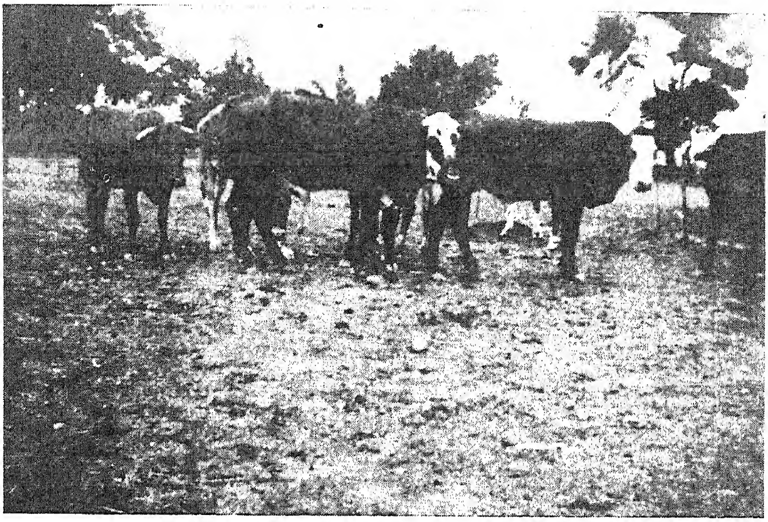


Fig. 1.—Type of ranch steer used in this experiment.

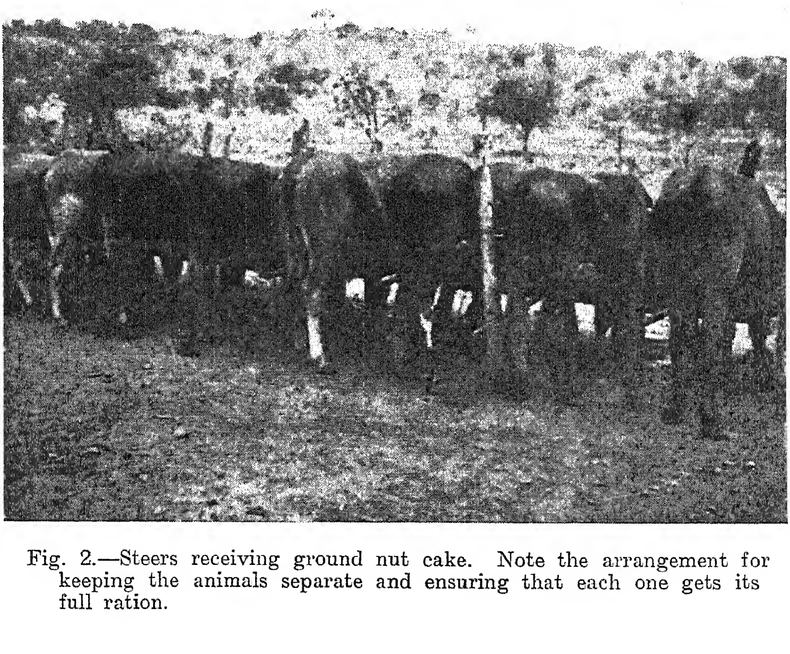


Fig. 2.—Steers receiving ground nut cake. Note the arrangement for keeping the animals separate and ensuring that each one gets its full ration.

There was a small difference of 32 lbs. in weight between Group 1 and 2 at this time, but the difference is not considered significant In height Group 1 was still slightly behind Group 2, but the difference is considered hardly significant (Table 2). The animals in Group 3 did very well. They maintained their weights until the commencement of the scouring period, when they lost on an average 91 lbs. In spite of this loss they were 178 lbs. heavier than Group 1 and 146 lbs. heavier than Group 2 at the end of this winter. These differences are sufficiently large to be definitely significant (Table 2).

The steers in Group 3 were 1.5 inches and 1.4 inches higher than those in Groups 1 and 2 respectively, and these differences are also large enough to be significant.

> The position at the end of the second winter might be summarised by saying that Groups 1 and 2 suffered severely during this second winter. Group 2 suffered more than Group 1, which had received no ground nut cake during the first winter. At the commencement of the second summer Groups 1 and 2 were for practical purposes very much the same, the difference in weight between the two groups being only 32 lbs. Group 3, which had received ground nut cake both winters was 162 lbs. ahead of the average weight of Groups 1 and 2.

Period D.—Second "Summer."—During this summer all three groups of steers made good gains. The total gains in weight made by Groups 1, 2 and 3 were 358 lbs., 384 lbs. and 314 lbs. respectively.

The slightly larger gains made by Group 2 as compared with Group 1 are probably due to the fact that they were in poorer condition at the commencement of the summer and had slightly larger frames. Group 3 started this period in good condition but made smaller gains on the grass than Groups 1 and 2 which had received no supplementary feed the previous winter. At the end of the second summer the weights of the steers in Groups 1, 2 and 3 were 839 lbs.,

897 lbs. and 973 lbs. respectively. The heights of the steers in the three groups were 48.1 inches, 48.3 inches and 50.4 inches respectively.

It will be seen from Table 2 that the difference in weight between Groups 1 and 2 was probably significant but that the difference in height of .2 inches was not significant. At this stage Group 3 steers were far ahead of the other two groups and would normally have been topped off as chillers and not kept for the further winter required by the plan of this experiment. Groups 1 and 2 were too light for economic topping off at this stage.

This result in favour of Group 3 cost 240 days' feeding (28/5/34—17/12/34) in the first winter and 210 days (14/6/35—9/1/36) in the second winter. One pound of ground nut cake was fed per head per day in the first and $1\frac{1}{2}$ lbs. in the second period, giving a total of 519 lbs. of ground nut cake. The heavy rate of feeding for such a lengthy period was undertaken in order to secure the scientific data required, although it was realised that such a course could probably not be followed, nor would be necessary, in ordinary commercial practice.

> The position at the end of the second summer might be summarised by saying that all groups had done well. Group 2 did slightly better than Group 1 on account of the larger frames, the result of the first winter's feeding. Group 3 (fed on ground nut cake both winters) was well ahead of the other two groups and was ready to be topped off as chillers.

Period E.—Third Winter and up to the conclusion of the Experiment.—From a grazing point of view this winter was an exceptionally good one. The steers in the unfed groups—Groups 1 and 2—lost very much less weight than during the two previous winters. Group 3, which had been fed ground nut cake in the previous winters, and which was fed again during the third winter, gained 12 lbs. Groups 1 and 2 which had received no supplementary feed lost 30 and 60 lbs. respectively. At the end of this winter the difference in weight between Groups 1 and 2 was 28 lbs., whilst Group 3 was

176 lbs. heavier than Group 1 and 148 lbs. heavier than Group 2. These differences are in the same order as during the previous winter.

The experiment was concluded on the 18th January, 1937, when all the steers were ready to be topped off as chillers for export overseas. During this summer all groups made very good gains. Groups 1 and 2 did slightly better on grass than Group 3, which is again what might have been expected from the experience of the previous summers when the steers which had not been fed supplements during the winter did comparativly better than those which had received supplements when on grass.

At the conclusion of the experiment the steers in Groups 1, 2 and 3 weighed on an average 953 lbs., 1,001 lbs. and 1,107 lbs. respectively. The heights of the respective groups were 50.0 inches, 50.4 inches and 52.1 inches. The differences in weight and height between Groups 1 and 2 are statistically not significant, though from figures 3 and 4 it is evident that some small differences did exist. On the other hand differences in weight between Groups 1 and 2 and Group 3 of 154 lbs. and 106 lbs. and 2.1 inches and 1.7 inches respectively are definitely significant and show the beneficial effect of supplementary feeding in the first two or three winters.

Conclusion.—The results of an experiment of this nature depend largely on the seasonal rainfall, and it is therefore not possible at this stage to do very much more than record the results of observations made during the course of the experiment. The following observations may, however, be of value even at this stage:—

(1) In this experiment the feeding of ground nut cake to young growing steers during their first winter after weaning, unless the feeding is repeated in the second winter, did not have much effect on their ultimate weight at commercial maturity or help them to go through subsequent winters without supplementary feeding.

(2) The increased weight and height of the steers at the end of the first winter, as the result of the supplementary feed, was maintained during the following summer only and was practically lost during the first winter in which supplementary feeding was discontinued.

The results confirm the impressions of the writers and the work is being continued and elaborated to obtain further data.

TABLE 1.

Average Weights and Heights of Steers.

	Date.	GROUP 1. Control.		GROUP 2. Ground nut cake supplement, 1st winter only.		GROUP 3. Ground nut cake supplement, 1st, 2nd & 3rd winters.	
		lbs.	ins.	lbs.	ins.	lbs.	ins.
1st Winter ...	17. 4.34	454	43.1	455	43.1	455	43.1
	16. 5.34	456	43.1	461	43.4	460	43.3
	13. 6.34	455	43.8	453	43.6	448	43.9
	11. 7.34	453	43.4	463	43.3	452	43.7
	8. 8.34	436	43.3	463	43.2	468	43.3
	5. 9.34	437	44.2	487	44.5	478	44.7
	3.10.34	433	44.0	488	44.2	487	44.2
	31.10.34	420	43.8	492	44.4	478	44.3
	28.11.34	404	43.6	479	44.4	474	44.6
1st Summer ...	27.12.34	461	44.1	543	44.8	538	44.8
	23. 1.35	503	44.5	585	45.5	574	45.6
	21. 2.35	597	44.8	665	45.9	669	46.1
	20. 3.35	642	45.1	719	46.1	707	46.6
	17. 4.35	664	45.6	740	46.4	723	47.3
	16. 5.35	686	46.5	755	47.5	741	47.9

Average Weights and Heights of Steers—(continued).

Date.		GROUP 1. Control.		GROUP 2. Ground nut cake supplement, 1st winter only.		GROUP 3. Ground nut cake supplement, 1st, 2nd & 3rd winters.	
		lbs.	ins.	lbs.	ins.	lbs.	ins.
2nd Winter ...	13. 6.35	668	46.9	728	47.3	728	47.9
	11. 7.35	646	46.7	704	47.5	728	48.2
	7. 8.35	636	46.9	683	47.5	731	48.5
	5. 9.35	628	47.1	677	47.4	751	48.7
	3.10.35	590	47.4	636	47.5	741	49.3
	5.11.35	567	46.9	613	47.5	746	48.7
	27.11.35	562	46.2	613	47.3	750	48.7
	3. 1.36	481	47.0	513	47.1	659	48.5
2nd Summer ..	23. 1.36	606	46.4	642	47.1	787	49.2
	20. 2.36	693	47.0	740	47.5	866	49.5
	18. 3.36	745	47.5	802	47.8	899	49.9
	15. 5.36	821	48.0	860	48.2	948	50.2
	9. 6.36	839	48.1	897	48.3	973	50.4
3rd Winter & until conclusion of experiment	8. 7.36	820	*	881	*	982	*
	5. 8.36	824	*	863	*	993	*
	1. 9.36	737	48.4	783	48.4	925	50.4
	30. 9.36	813	49.0	854	49.1	991	51.0
	28.10.36	804	*	844	*	1015	*
	24.11.36†	809	*	837	*	985	*
	23.12.36	902	50.0	927	50.3	1050	51.9
	18. 1.37	953	50.0	1001	50.4	1107	52.1

*No height measurement taken.
†End of "winter" period.

TABLE 2.

Summary and Statistical Analysis of Growth Data Weights (lbs).

Date.	Stage.	GROUP 1. (Control).	GROUP 2. (Supplement 1st Winter only).		GROUP 3. (Supplement 1st, 2nd and 3rd Winters).		
		Average live-weight and S.E. of Mean.	Average live-weight and S.E. of Mean.	Average Gain or Loss over Control and S.E. of difference.	Average live-weight and S.E. of Mean.	Average Gain or Loss over Control and S.E. of difference.	Average Gain or Loss over Gr. 2 and S.E. of difference.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
17. 4.34	Commencement	454±12	455±12	1±17	455±11	+ 1±16	0 ±17
28.11.34	End 1st Winter	404±11	479±15	75±19	474±11	+ 70±16	— 5±19
16. 5.35	End 1st Summer	686±14	755±18	69±23	741±16	+ 55±21	— 14±24
3. 1.36	End 2nd Winter	481± 9	513±18	32±20	659±14	+178±16	+146±23
9. 6.36	End 2nd Summer	839±14	897±26	58±30	973±18	+134±23	+ 76±31
18. 1.37	End of Experiment	953±16	1001±33	48±37	1107±32	+154±36	+106±46

Height at the Withers (inches).

Date.	Stage.	GROUP 1.	GROUP 2.		GROUP 3.		
		inches.	inches.	inches.	inches.	inches.	inches.
17. 4.34	Commencement	43.1±.39	43.1±.35	0.0±.58	43.1±.42	0.0±.58	0.0±.55
28.11.34	End 1st Winter	43.6±.40	44.4±.33	0.8±.51	44.6±.35	+1.0±.53	+0.2±.48
16. 5.35	End 1st Summer	46.5±.41	47.5±.30	1.0±.50	47.9±.41	+1.4±.58	+0.4±.50
3. 1.36	End 2nd Winter	47.0±.55	47.1±.45	0.1±.71	48.5±.39	+1.5±.67	+1.4±.60
9. 6.36	End 2nd Summer	48.1±.46	48.3±.52	0.2±.69	50.4±.41	+2.3±.62	+2.1±.66
18. 1.37	End of Experiment	50.0±.46	50.4±.55	0.4±.71	52.1±.51	+2.1±.69	+1.7±.75

Analyses of Rhodesian Foodstuffs.

By The Division of Chemistry.

A considerable amount of data is available in such valuable textbooks as Henry & Morrison, Hall, Wood, Kellner, and those of many other authors regarding the chemical composition of animal foodstuffs, but these analyses refer to products that have been grown in countries other than our own.

During past years many Rhodesian grasses, legumes, cereals, and other common animal foodstuffs produced and fed in the Colony have been analysed for various purposes in the chemical laboratories of the Department of Agriculture, and it has long been felt that the analytical data available put in the form of a bulletin might be of value to farmers and others.

The increased attention being paid to the feeding of cattle makes the demand for a series of analysis of our commoner foodstuffs more urgent, and it has therefore been decided to issue the following tables, as it is felt that the information contained therein will be of value in assisting farmers in compiling suitable balanced rations for stock from the foodstuffs available on their farms.

In most textbooks giving the analyses and nutritive ratios of foodstuffs the latter are usually computed from the digestible and not from the crude nutrients.

No digestibility trials on cattle have ever been carried out in this Colony, therefore no data are available to show the digestibility of any of our common foodstuffs.

In the circumstances, the nutritive ratios shown in the last column of these tables have been calculated on the crude nutrients, and, although not in accordance with the usual method adopted, it is considered that they will prove useful in classifying foodstuffs, as they show the relative proportion of proteins to carbohydrates and fats.

Calculations.—The Protein Factor.—The protein content of foodstuffs is ascertained by determining the nitrogen content and multiplying this figure by the factor 6.25.

This factor is derived from the assumption that the whole of the nitrogen present in foodstuffs is in the form of protein and that all proteins contains 16 per cent. of nitrogen, *i.e.*, $\frac{100}{16}$. This figure is fairly accurate for animal proteins, but is only roughly correct for vegetable proteins, as these latter contain more nitrogen than animal proteins. Factors varying from 5.5 to 6.25 have been suggested for different vegetable proteins, but although 6.25 is too high for a number of these, this factor has been used throughout for calculating the protein content of all the foodstuffs in the following tables.

The Nutritive Ratios in these tables are calculated by adding to the percentages of carbohydrates and fibre, the percentage of fat multiplied by 2.3, and dividing the sum by the precentage of crude protein, so arranged that the numerator is unity. Thus:—

$$\text{Nutritive Ratio} = \frac{\text{Crude Protein.}}{(\text{Fat x } 2.3) + \text{Soluble Carbohydrates} + \text{Fibre.}}$$

$$= \frac{1}{\dfrac{(\text{Fat x } 2.3) + \text{Soluble Carbohydrates} + \text{Fibre.}}{\text{Crude Protein.}}}$$

PERCENTAGE COMPOSITION OF RHODESIAN FOODSTUFFS.

I.—CONCENTRATES.

(a) *Grains and Seeds.*

	Moisture.	Ash.	Crude Protein.	Ether Extract.	Fibre.	Carbo-hydrates.	Nutritive Ratio.
	%	%	%	%	%	%	
Buckwheat	9.14	2.55	10.50	2.56	14.45	60.80	1:7.7
Kaffir Corn (2 analyses)...	10.92	1.64	10.90	2.48	2.17	71.89	1:7.3
Linseed Grain (white flowering)...	6.97	3.84	22.75	30.23	5.67	30.54	1:4.6
Maize (Dent)	7.0	1.3	9.4	4.5	1.9	75.9	1:9.1
Maize (Flint)	7.4	1.8	10.9	5.3	1.9	72.7	1:7.8
Maize (Hickory King) ...	9.8	1.2	9.3	4.4	1.4	73.9	1:9.2
Maize (Salisbury White)...	10.2	1.4	9.3	4.7	1.5	72.9	1:9.2
Milo Maize	8.74	1.57	10.98	2.67	2.66	73.38	1:7.6
Nyouti (Munga)	9.42	2.18	11.37	4.31	1.57	71.15	1:7.3
Oats, Hull-less...	11.43	2.13	21.00	7.81	2.00	55.63	1:2.8
Oats, Kherson	9.51	3.90	15.31	5.32	11.26	54.70	1:5.1
Oats, Kinvarra	9.66	3.92	12.25	8.70	13.71	51.76	1:7.0
Panicum sp. (Native grass seed)...	11.12	2.20	8.18	1.55	3.48	73.47	1:9.8
Pumpkin seeds	5.54	3.93	33.91	39.57	15.05	2.00	1:3.2
Rapoko	10.58	3.16	7.62	1.30	2.88	74.46	1:10.8
Rice (Native)...	9.2	5.8	10.6	2.0	10.3	62.1	1:7.2
Sunflower heads...	10.49	5.15	12.25	12.90	24.52	34.69	1:7.3
Sunflower seed (Black sel.)	5.76	2.28	14.37	26.77	25.24	25.58	1:7.8
Sunflower seed (White sel.)	5.54	2.61	16.63	24.86	25.99	24.37	1:6.5
Vi-Vi (Lucaena glauca) seed...	9.0	4.0	32.6	6.8	10.4	37.2	1:1.9
Wintersome seeds	9.9	2.1	11.4	3.6	3.6	69.4	1:7.1

(b) *Miscellaneous Concentrates.*

Coffee bran	11.9	4.3	2.0	0.2	60.3	21.3	1:4.1
Copra cake	4.9	4.2	13.1	33.3	8.7	35.8	1:9.2
Corn and Cob meal...	12.4	1.4	8.3	4.1	4.7	69.1	1:10.0

(b) *Miscellaneous Concentrates—(continued).*

	Moisture.	Ash.	Crude Protein.	Ether Extract.	Fibre.	Carbo-hydrates.	Nutritive Ratio.
	%	%	%	%	%	%	
Cotton seed cake	7.3	4.9	33.6	13.3	13.4	27.6	1:2.1
Germ Meal ... ... (2 analyses).	12.1	2.8	9.1	5.3	3.6	67.2	1:9.2
Ground Nut Cake ... ... (decorticated)	6.2	4.1	45.9	16.2	4.5	23.1	1:1.4
Hominy Chop ... ... (3 analyses).	10.26	1.48	8.75	4.56	4.90	70.06	1:9.8
Locust Meal...	7.06	6.84	47.47	22.91	10.81	4.91	1:1.4
Maize Alcohol Residue ...	10.1	4.3	27.8	12.1	8.8	36.9	1:2.7
Maize Bran	8.4	1.8	7.9	5.6	14.8	61.5	1:11.3
Mealie Meal ... ... (3 analyses).	10.22	1.30	8.58	4.69	1.96	72.61	1:9.9
Mimosa Meal	7.06	4.15	11.25	0.92	21.18	55.44	1:7.0
Palm Kernel Cake ... ... (2 analyses).	7.8	2.5	13.7	13.5	18.6	43.9	1:6.8
"Seepu"...	9.92	13.91	12.19	2.30	10.19	51.49	1:5.2
Sunflower Heads, seeds removed...	11.73	11.62	8.86	3.18	18.19	46.42	1:8.1
Wheat Screenings	8.8	7.2	11.2	2.1	13.4	57.3	1:6.7

(c) *Slaughter-house By-products.*

Blood Meal ... ... (2 analyses).	9.48	3.60	80.50	0.28	0.91	5.23	1:0.08
Bone Meal ... ... (2 analyses).	6.4	67.1	20.6	2.2	0.9	2.8	1:0.4
Meal Meal ... ... (3 analyses).	6.7	15.4	56.8	17.3	2.3	1.5	1:1.3

(d) *Leguminous Pods and Seeds.*

Acacia albida (entire pods)	7.1	3.4	11.1	1.4	27.5	49.5	1:7.2
Acacia arabica (entire pods)...	9.2	4.0	10.9	2.9	15.7	57.3	1:7.3
Acacia benthami (beans)...	6.96	3.45	12.56	4.57	9.46	63.00	1:6.6
Acacia sp. (entire pods)...	8.58	5.65	14.22	1.48	21.55	48.52	1:5.2

(d) Leguminous Pods and Seeds—(continued).

	Moisture.	Ash.	Crude Protein.	Ether Extract.	Fibre.	Carbo-hydrates.	Nutritive Ratio.
	%	%	%	%	%	%	
Albizzia amara (entire pods)	9.31	3.29	12.25	6.89	32.69	35.57	1:6.9
Bauhinia thonningii (entire pods)	6.1	3.9	6.6	3.1	23.7	56.6	1:13.2
Camelthorn (Acacia giraffeae) (entire pods) ...	9.36	3.29	11.37	1.61	30.98	43.39	1:6.9
Carob bean (Ceratonia siliqua) (pods without seeds)	5.68	2.25	3.24	2.09	9.90	76.84	1:28.3
Carob bean (seed)	8.14	3.44	16.38	2.55	7.93	61.56	1:4.6
Carob bean (entire pods) ...	6.10	2.45	5.48	2.17	9.56	74.24	1:16.2
Cowpeas, or Kaffir beans (seeds)	13.9	3.4	23.4	1.8	5.9	51.6	1:2.6
Dichrostachys nutans (bean)	7.08	4.59	18.55	2.07	20.27	47.44	1:3.9
Dolichos bean (seed)	8.03	3.90	24.72	1.00	9.77	52.58	1:2.6
Gram, large white (seed)	5.66	2.34	20.13	5.74	2.41	63.72	1:3.9
Gram, brown (seed)	6.31	2.64	21.90	4.37	10.81	53.97	1:3.4
Gram, horse (seed)	4.3	6.8	23.6	0.6	7.5	57.2	1:2.8
Ground Nuts—							
Rhodesian Valencia—							
Entire pods	7.36	2.35	24.71	36.31	16.02	13.25	1:4.6
Husks	10.65	3.06	4.81	0.98	61.16	19.34	1:17.2
Kernels	6.36	2.14	30.79	47.10	2.23	11.38	1:4.0
Virginia Bunch—							
Entire pods	8.82	2.64	22.07	32.90	18.12	15.45	1:4.9
Husks	10.84	2.40	4.58	1.09	64.50	16.59	1:18.2
Kernels	8.15	2.73	27.94	43.57	2.56	15.05	1:4.2
Madagascar Butter Bean (entire pods)	9.3	3.6	11.8	1.8	26.0	47.5	1:6.6
Mung Bean (Black-seeded) (seeds)	4.4	6.5	26.3	0.6	4.3	57.9	1:2.4
Nyomo (bean)	9.4	3.6	16.3	6.8	5.7	58.2	1:4.9
Somerset Velvet Beans (beans only)	11.0	3.1	22.9	5.1	5.7	52.2	1:3.0
Somerset Velvet Beans (entire pods)	10.4	3.4	13.3	3.0	14.3	55.6	1:5.8
Soya Bean. Biltan (seed)	7.8	4.1	40.3	16.1	4.9	26.8	1:1.7

(d) Leguminous Pods and Seeds—(continued).

	Moisture.	Ash.	Crude Protein.	Ether Extract.	Fibre.	Carbo-hydrates.	Nutritive Ratio.
	%	%	%	%	%	%	
Soya Bean. Herman (seed)	8.1	4.4	36.7	18.7	4.9	27.2	1:2.0
Soya Bean. Otoxi (seed)	7.9	4.2	45.2	16.6	4.4	21.7	1:1.4
Sunnhemp (seed)	7.6	3.6	29.4	3.5	11.1	44.8	1:2.2
Swartzia Madagascariensis (entire pods)	8.86	2.43	5.69	1.12	21.10	60.80	1:15.0
Velvet Bean (White Stingless) (seed)	10.18	3.57	26.94	6.13	3.11	50.10	1:2.5
Velvet Bean (White Stingless) pods without contained seeds...	9.49	5.06	4.19	0.98	27.27	53.01	1:19.7
Velvet Bean (White Stingless) (entire pod) ...	9.87	4.21	16.89	3.85	13.78	51.40	1:4.4
Vi-Vi (Lucaena glauca) (entire pods)	19.5	4.7	17.5	1.1	20.6	36.6	1:3.4

II.—DRIED ROUGHAGE.

(a) Hay from Grasses, etc.

Black Turf grass (Ischaemum glaucostachyum)	13.19	9.15	9.56	1.80	32.09	34.21	1:7.2
Buffalo grass (Setaria Chevalieri)	9.40	11.16	11.25	2.06	24.87	41.26	1:6.3
Climbing Belhambra (Phytolacca octandra)... ...	13.9	11.3	22.8	2.1	15.0	34.9	1:2.4
Common Buffel or Guinea grass (Panicum maximum)	13.11	11.74	12.38	1.49	23.13	38.15	1:5.2
Chloris virgata (old lands grass)...	12.15	9.91	9.07	1.55	30.02	37.30	1:7.8
Digitaria setivalva	11.30	10.13	11.69	2.30	24.54	40.04	1:6.0
Dryland grass (Pennisetum ciliare)	10.57	11.60	14.88	1.66	28.50	32.79	1:4.4
Gonya grass (Urochloa bulbodes)	10.74	11.54	15.81	1.77	21.98	38.16	1:4.1
Gonya grass (Urochloa mosambicensis)...	11.53	11.36	13.06	1.32	24.71	38.02	1:5.0
Hunyani grass (Chloris gayana) creeping strain	9.90	8.36	9.31	1.74	28.83	41.86	1:8.0
Limpopo grass, S.A.; Antelope grass, Rhod. (Echinochloa pyramidalis)...	17.55	8.41	12.88	1.99	27.55	31.62	1:4.9

(a) Hay from Grasses, etc.—(continued).

	Moisture.	Ash.	Crude Protein.	Ether Extract.	Fibre.	Carbo-hydrates.	Nutritive Ratio.
	%	%	%	%	%	%	
Manna Hay	6.2	7.3	7.0	1.2	30.2	48.1	1:11.6
Milanje grass (Digitaria milanjiana)	10.41	8.23	11.19	2.12	26.16	41.89	1:6.5
Purple topped Buffel (Panicum maximum)	12.64	11.48	14.13	1.60	21.48	38.67	1:4.5
Rapoko grass	11.08	8.40	11.00	1.57	28.84	39.11	1:6.5
Reed Timothy grass (Setaria phragmatoides) ...	11.31	12.08	15.00	1.22	28.39	32.00	1:4.2
Rhodesian Blue grass (Andropogon gayanus) ...	9.53	6.37	10.50	2.29	30.82	40.49	1:7.5
Rhodes grass (Chloris gayana) (5 analyses)	7.9	7.0	8.5	1.2	36.9	38.5	1:8.9
Smooth Rhodesian Tussock grass (Setaria plicatilis)	11.84	8.90	13.69	2.02	29.05	34.50	1:5.0
Setaria pabularis	11.23	12.72	13.00	0.88	29.28	32.89	1:4.9
Spekboom (Portulacaria Afra)	4.4	9.4	8.1	3.6	20.0	54.5	1:10.2
Sunflower plants (complete)	7.74	7.90	11.50	6.79	31.80	34.27	1:7.1
Swamp Couch (Haemarthria fasciculata)	17.64	5.79	6.63	1.52	26.68	41.74	1:10.8
Teff Grass	10.9	6.7	10.4	1.7	26.2	44.1	1:7.1
Upright False Paspalum (Brachiaria brizantha)	14.77	10.23	9.31	1.66	26.30	37.73	1:7.3
Wintersome fodder...	13.3	4.4	4.1	0.8	26.0	51.4	1:19.3
Woolly Finger grass (Digitaria pentzii)	11.46	8.43	14.25	2.01	28.58	35.27	1:4.8

(b) Hay from Legumes.

Cow Pea Hay	10.0	7.3	10.0	1.1	29.6	42.0	1:7.4
Crotalaria intermedia	7.5	5.7	14.4	1.5	33.3	37.6	1:5.2
Dahl	12.00	3.73	20.12	1.80	6.84	55.51	1:3.3
Dolichos Bean Hay	11.1	6.5	12.1	2.4	21.3	46.6	1:6.1
Ground Nut Hay	9.5	11.9	10.6	1.3	27.0	39.7	1:6.6
Kudzu vine (complete) ...	4.52	6.28	13.38	2.43	34.57	38.82	1:5.9
Kudzu vine (leaves)	8.05	7.13	18.06	3.56	19.81	43.39	1:4.0
Kudzu vine (stalks)	7.81	5.19	5.29	0.95	42.63	38.12	1:15.7
Lucerne (flowering stage)	74.0	2.0	4.5	0.8	9.5	9.2	1:3.2
Lupinaria	...	...	12.13	...	...	...	...
Soya Bean (Biltan) Hay...	15.4	5.8	9.9	3.0	31.6	34.3	1:7.4

(b) Hay from Legumes (continued).

	Moisture.	Ash.	Crude Protein.	Ether Extract.	Fibre.	Carbo-hydrates.	Nutritive Ratio.
	%	%	%	%	%	%	
Sunnhemp Hay (4 analysis)	7.66	5.11	11.42	1.01	42.17	32.63	1:6.8
Vaalbosch (Eriosema Engleri)	12.80	4.68	9.31	2.94	27.50	42.77	1:8.3
Velvet Bean Hay...	9.3	7.8	13.3	2.5	27.6	39.5	1:4.2

(c) Dried Roughage from Miscellaneous Green Leaves of Trees, Plants, etc.

	Moisture.	Ash.	Crude Protein.	Ether Extract.	Fibre.	Carbo-hydrates.	Nutritive Ratio.
Banana leaves	10.2	10.9	12.8	2.0	26.6	37.5	1:5.4
Banana stems	12.4	16.2	5.8	1.3	22.7	41.6	1:11.6
Dolichos bean leaves... ...	...	...	17.3	...	...	...	...
Dolichos bean stems	...	...	7.25	...	...	...	...
Emfenge leaves (Cussonia spicata)...	22.1	6.1	6.7	2.7	15.4	47.0	1:10.0
Granadilla leaves	8.92	8.13	15.37	4.64	10.88	52.06	1:4.8
Indigofera, leaves and flowers	...	...	20.0	...	...	...	...
Madagascar Butter Bean, leaves and stalks... ...	9.2	7.4	8.1	3.6	36.9	34.8	1:9.9
M'futi tree leaves	...	...	16.2	...	...	...	...
Paw Paw leaves...	9.7	11.1	22.5	3.9	9.7	43.1	1:2.7
Sunflower leaves	78.70	3.95	4.12	0.70	1.97	10.56	1:3.4
Vaalbosch leaves	6.22	7.99	14.06	8.39	26.44	36.90	1:5.9
Vi-Vi (Lucaena glauca) branches...	13.2	7.0	18.6	2.8	19.3	39.1	1:3.5
Vi-Vi (Lucaena glauca) leaves only	10.4	10.0	17.9	5.8	12.6	43.3	1:3.9
Willow leaves (common)...	11.0	5.2	9.8	2.8	17.4	53.8	1:7.9
Willow leaves (weeping)...	13.9	8.8	14.4	2.5	15.5	44.9	1:4.6

III.—FRESH ROUGHAGE.

(a) Roots, Tubers, Fruits.

	Moisture.	Ash.	Crude Protein.	Ether Extract.	Fibre.	Carbo-hydrates.	Nutritive Ratio.
Edible Canna tubers (first year)	88.1	0.72	0.72	0.03	0.53	9.90	1:15.0
Edible Canna tubers (second year)	84.4	0.60	0.77	0.04	0.63	13.56	1:20.0
Kigelia pinnata (Sausage tree), fruit only	85.4	0.66	0.84	0.88	4.29	7.93	1:17.0
Majorda Melon	94.62	0.36	0.44	0.03	0.43	4.12	1:10.5

III.—FRESH ROUGHAGE—(*continued*).

	Moisture.	Ash.	Crude Protein.	Ether Extract.	Fibre.	Carbo-hydrates.	Nutritive Ratio.
	%	%	%	%	%	%	
Prickly Pear fruit, complete	...	...	0.70	...	...	...	...
Prickly Pear fruit, pulp	...	...	0.88	...	...	...	...
Pumpkins	86.8	0.90	1.8	0.80	1.8	7.9	1:6.4
Sweet potato tubers	78.70	0.70	1.38	0.16	0.38	18.68	1:14.0

IV.—SILAGE.

	Moisture.	Ash.	Crude Protein.	Ether Extract.	Fibre.	Carbo-hydrates.	Nutritive Ratio.
Dolichos beans—							
Green	76.19	2.12	4.44	1.28	5.25	10.72	1:4.3
Air-dried	11.74	7.87	16.44	4.76	19.45	39.74	
Kudzu Vine—							
Green	62.71	4.33	4.95	1.55	11.59	14.87	1:6.1
Air-dried	13.88	10.00	11.44	3.57	26.77	34.34	
Maize—							
Green	70.79	1.45	2.08	1.68	2.80	21.20	1:13.4
Air-dried	12.13	4.37	6.25	5.08	8.42	63.75	
Napier Fodder—							
Green	73.08	3.67	1.14	0.98	10.49	10.64	1:20.5
Air-dried	10.10	12.26	3.81	3.29	35.03	35.51	
Niger Oil Plant—							
Green	66.80	3.95	4.69	4.99	7.41	12.16	1:6.6
Air-dried	7.27	11.05	13.12	13.96	20.71	33.89	
Sunflower—							
Green	81.44	2.26	2.94	1.10	3.04	9.22	1:5.0
Air-dried	11.40	10.79	14.06	5.26	14.48	44.01	
Sweet Potato tops—							
Green	82.69	2.14	2.77	0.81	2.65	8.94	1:4.9
Air-dried	11.70	10.92	14.13	4.12	13.54	45.59	
Sunnhemp (green)	78.24	2.00	2.53	0.69	10.71	5.83	1:7.2
Tango Daisy fodder (Tithonia) (green)	79.0	2.3	1.8	0.3	9.4	7.2	1:9.9
Tango Daisy fodder (Tithonia) (air-dried)	14.9	9.2	7.2	1.4	38.1	29.2	
Veld Grass (Red soil) air-dried (3 analyses)	14.8	7.9	5.7	1.6	26.2	43.8	1:12.9
Veld Grass (Sandveld), air-dried (2 analyses)	9.7	7.2	3.7	0.6	40.1	38.7	1:22.0
Vlei Grass, air-dried (3 analyses)	10.6	8.6	5.5	2.3	33.5	39.5	1:14.2
Velvet Bean—							
Green	81.11	2.29	2.94	1.17	5.00	7.49	1:5.2
Air-dried	9.43	11.01	14.12	5.62	23.98	35.84	
Velvet Bean, plus Maize air-dried	7.6	3.1	10.2	3.8	12.9	62.4	1:8.2

Salisbury Agricultural Experiment Station

ANNUAL REPORT OF EXPERIMENTS: SEASON 1935-36.

By H. C. Arnold, Manager.

The commencement of the season was not favourable to crop growth owing to the droughty conditions which prevailed, but in the latter half the rainfall was sufficient to meet the needs of the crops, which improved rapidly, and heavy yields were recorded. The total precipitation amounted to 24.01 inches, which is 4.5 inches less than the average for the previous ten years.

Analysis of Rainfall Season 1935-36.

Month.	No. of rain days.	Total for the month.	No. of rains over $\frac{1}{4}$ in.	Total to end of month.	Periods exceeding one week without rain.
October...	1	.11	—	.11	Oct. 29th to Nov. 5th.
November	6	2.97	3	3.08	Nov. 9th to Nov. 21st.
December	8	4.40	6	7.48	Nov. 25th to Dec. 4th.
January...	14	3.99	7	11.47	Dec. 21st to Jan. 1st; Jan. 22nd to Jan. 29th.
February	14	6.54	7	18.01	
March	17	5.44	9	23.45	
April...	8	.56	1	24.01	April 5th to April 13th.
Totals	68	24.01	33		
Average for the previous 10 years...	71	28.51	33.5		

This tabulation shows that although the total rainfall was considerably below the average it was fairly evenly distributed during the period January to March. The yield of maize was 30% to 50% heavier than it was in previous seasons with a larger total precipitation, indicating that February and March are critical months in the development of that crop.

The results of experiments conducted at this Station since 1919-20 are available for reference in bulletin form, and to facilitate comparison this report is drawn up on similar lines to previous ones.

Having served their purpose the following experiments were discontinued :—

(1) Ground nut fertiliser trials.
(2) Ground nut distance-planting trials.
(3) Sunnhemp for seed production. Date-planting trials.
(4) Sunnhemp selections for heavy seeding strains.

New investigations commenced were as follows :—

(1) Comparison of various methods of treating the top-growth of the sunnhemp crop for the restoration of soil fertility.

(*a*) Ploughing under in the usual way.
(*b*) The stubble only ploughed under; immature top growth composted and returned to the same land.
(*c*) The stubble only ploughed under; matured top growth burnt on the land.
(*d*) The stubble only ploughed under; immature top growth removed, and after composting applied to land previously cropped with maize.
(*e*) Maize followed by maize which receives the compost made from the sunnhemp top growth of (*d*).
(*f*) Maize continuously without any applications of humus treatment.

(2) Investigation of the effect of climatic conditions subsequent to ploughing under green manure, on the following maize crop, sunnhemp to be sown at fortnightly intervals, between November 15th and January 15th and ploughed under three months after germination.

(3) Comparison of various rates of seeding sunnhemp, in relation to their effect on the nitrogen content of the soil and the yield of maize in the following season.

(4) Soya beans. Date-planting trials of edible varieties.

(5) Soya beans. Trials with hybrid strains for fodder and seed retention.

(6) Velvet beans. Trials with hybrids for the purpose of establishing superior strains for hay production.

CROP ROTATION EXPERIMENTS.—FIRST SERIES 1913-1936.

Maize Yields in Bags per Acre.

System of Cropping.	1935-36 Rainfall 24.01	1934-35 Rainfall 31.07	1933-34 Rainfall 31.54	1932-33 Rainfall 27.64	1931-32 Rainfall 26.62	1930-31 Rainfall 31.47	1929-30 Rainfall 23.46	Avge. yield.
*A1—Maize continuous. Green manure and 250 lb. per acre of phosphatic fertiliser in the seasons 1928-29 and 1932-33 ...	Green manure ploughed under	4.99	19.04	Green manure ploughed under	9.60	12.60	15.88	12.42 (5 crops)
*A2—Maize continuous. Fertiliser only, rates as above	6.12	2.01	8.74	3.53	10.92	2.99	11.44	6.49 (8 crops)
†B — Alternate maize and beans for hay; no manure or fertiliser	11.70	4.45	6.60	2.34	10.02	1.95	6.43	9.33
C—Three-course rotation: Maize, velvet beans (reaped), oats; no manure or fertiliser	13.25	5.82	10.75	4.90	11.10	11.70	11.36	13.44
D—Four-course rotation: Maize, (plus 6 tons dung per acre), oats, bean hay, maize. Average of two plots ...	14.82	6.81	14.70	14.21	16.33	14.93	15.79	
Maize (no manure direct)	16.63	6.82	11.90	14.40	14.80	14.95	13.25	16.85 (19 years)
Maize (dunged plots)	13.00	6.80	17.50	14.02	17.85	14.90	18.33	17.17

***Note.**—Having grown maize for 15 years in succession without manure or fertiliser, during which time its yields had gradually decreased until they had become so low as under practical field conditions to have rendered them negligible, this plot had served its purpose. With the object of comparing two methods of again raising the cropping power of such land to a more profitable standard the whole plot was treated with a mixture of one-third bone meal and two-thirds superphosphate at the rate of 250 lbs. per acre at the beginning of 1928-29 season. One-half of the plot was then planted to maize while the other half was sown to a mixture of sunnhemp and velvet beans, which were subsequently ploughed in. This manurial treatment was repeated on the respective plots during the season 1932-33.

†In 1929-30 this system was amended from "Alternate Maize and Bare Summer Fallow" to "Alternate Maize and Beans for Hay."

System A.—It is now eight years since this plot was subdivided as described above. During that period three crops of green manure and five crops of maize have been grown on sub-plot A1, the total maize production amounting to 62.10 bags per acre. The eight crops of maize obtained from the other sub-plot together amount to 51.92 bags. So there is a difference of 10.18 bags in favour of the green-manured sub-plot in addition to the lower costs of production and the benefit accrued from the green manure crop which was ploughed under during the season under review.

System B.—The yield of 11.70 bags per acre recorded this season is the highest obtained since the year 1926. Although the favourable climatic conditions are no doubt largely responsible for this heavy yield, it appears safe to assume that the change from "bare summer fallow" to beans for hay has had a beneficial influence on the yield of the maize crop in this system.

System C.—Although neither manure nor fertiliser has been applied to these plots during the twenty-three years the land has been under cultivation, the maize crop was heavy during the season under review. The benefit to be derived from rotational cropping is well illustrated by these results.

System D.—In common with all the other plots in these trials, larger yields were obtained this season than have been recorded during recent years. The application of a small quantity of farmyard manure every fourth year, combined with the diversified cropping system, is largely responsible for this higher state of fertility. It is remarkable, however, that there is little difference between the yields obtained from the maize crops to which manure is directly applied and that of the crops which occur four years after the manurial application. The reason for this would seem to be that the beneficial effect of the manure extends over the whole period of four years, and this, combined with the benefit derived from the preceding bean crop, results in yields from the unmanured plots equal to that of the crops receiving the manure direct.

SECOND SERIES OF CROP ROTATIONS.

These rotations were laid down in 1919-20 and were designed to evolve a system of cropping which would meet the needs of farmers who could not adopt mixed farming. The series included two plots, A. and F., on which maize was grown continuously for ten years without manure or fertiliser to serve as checks on the results from the rotations. For this purpose the cropping of Plot A. continues as in the past, but on Plot F. commencing season 1929-30, fertiliser is applied in alternate years. The fertiliser treatment given to this plot is the same in quantity and quality as that accorded in rotational System H., but green-manuring is entirely omitted.

Plot A: System E.—Maize continues without manure or fertiliser.

Seasons and Yields of Maize in Bags per Acre.

1935-36.	1934-35.	1933-34.	1932-33.	1931-32.	1930-31.	Avge. over 17 years.
6.88	2.21	4.60	1.74	11.60	2.33	9.63

The favourable climatic conditions which prevailed this season are responsible for the increased yield recorded for this plot which is seen to be roughly three times as much as that of the previous season. Comparison with previous seasons results shows that farmers who do not follow a balanced rotational system are largely dependent on the vagaries of the weather. The average yield for the past four years is less than four bags per acre, and it is doubtful whether the cash return from such poor crops would cover production costs.

Plots B to E: System F.—Three-quarters of the land under maize, one quarter under Sudan grass. Each year one section under maize, commencing with Plot B in 1919-20, receives eight tons of farm manure per acre, and commencing on Plot E in 1929-30, the section which grew Sudan grass the previous season receives 200 lbs. per acre of superphosphate (19 per cent. P_2O_5).

Maize Yields in Bags per Acre.

	1935-36.	1934-35.	1933-34.	1932-33.	1931-32.	1919-20.	Average 1920-36
Plot B... ...	*19.55	†7.19	Sudan	9.72	*22.65	26.0	17.15
Plot C... ...	†15.93	Sudan	15.45	*10.75	†19.33	23.7	15.38
Plot D... ...	Sudan	6.05	*18.80	†11.05	Sudan	Sudan	15.76
Plot E... ...	16.68	*6.99	†17.73	Sudan	19.23	24.6	15.99
Average ...	17.39	6.74	17.33	10.51	20.41	24.7	16.07

*Indicates the application of farmyard manure.

†Indicates the application of 200 lbs. per acre superphosphate.

In previous reports it has been noted that the average yield obtained in this rotation during the first five-year period was 17.4 bags per acre; during the second five-year period it was 14.62 bags per acre. The average yield for the five-year period 1931-36 was 14.48 bags per acre. This shows that the addition of 200 lbs. per acre of phosphate to the manurial dressing has done much to arrest the decline in yields which took place, but because the yields have not increased during the last period, it is indicated that applications of 8 tons of farmyard manure and 200 lbs. of superphosphate during each four-year period are the minimum amounts required to maintain the fertility of the land at a moderate level, when maize constitutes such a large proportion of the rotation.

Plot F: System G.—Maize continuous. No manure or fertiliser during the first ten years. Commencing season 1929-30, fertiliser consisting of one-third bone meal and two-thirds superphosphate at the rate of 200 lbs. per acre is applied every alternate year.

Seasons and Yields of Maize in Bags per Acre.

1935-36.	1934-35.	1933-34.	1932-33.	1931-32.	1930-31.	1919-20.	Avge. over 17 years.
*15.26	3.70	*14.55	5.33	*21.08	7.03	23.3	11.55

*Indicates the application of 200 lbs. per acre fertiliser.

The returns from this plot show remarkable alternations of low and high yields. It happens that favourable climatic conditions have synchronised with the fertiliser applications, and this accounts for the yield recorded this season being almost as heavy as that of the rotations which receive humus in addition to the fertiliser. The average yield for the six-

year period 1930-36 was 10.97 bags per acre. This is 2.85 bags per acre per annum less than that of System F. where farmyard manure is applied at the rate of two tons per acre per annum, and only one dressing of fertiliser is given in four years. It is also 1.66 bags per acre less than the average yield over the same period on System H., where the same amount of fertiliser is used and the land is green-manured.

Plots G to K: System H.—Three-quarters of the land under maize, one-quarter under velvet beans, which are ploughed under for green manure. From the commencement of this experiment until 1928-29 this land received one green-manuring and one application of fertiliser during each period of four years. The returns from these plots showed that insufficient plant food had been supplied to maintain fertility, and the manurial system was then amended to provide for two dressings of fertiliser during each four-year period. The crop of maize which follows the green-manuring now receives 200 lbs. of 19 per cent. superphosphate per acre, which should enable it to make better use of the nitrogen supplied by the green manure; the second maize crop receives no fertiliser, and the third crop, that immediately in front of the green crop, receives 200 lbs. per acre of a mixture of bone meal and superphosphate.

Maize Yields in Bags per Acre.

	1935-36.	1934-35.	1933-34.	1932-33.	1931-32.	1919-20	Average 1920-36
Plot G... ...	14.78	*14.58	Beans	*5.94	12.75	*23.10	14.77
Plot H... ...	*20.28	Beans	*14.50	9.32	*22.45	23.00	15.89
Plot J... ...	Beans	*4.34	12.25	*10.65	Beans	Beans	13.57
Plot K... ...	*15.35	3.59	*19.65	Beans	*16.50	19.20	14.29
Average ...	16.80	7.50	15.47	8.63	17.23	21.70	14.63

*Denotes application of fertiliser.

Excepting for the season 1931-32, the average yield of 16.80 bags per acre obtained this season is the highest recorded for twelve years. Although this indicates that the productivity of this land is being fairly well maintained by the manurial treatment it is receiving, it cannot be claimed that the fertility of the soil is being raised to a higher level, because the low yields which have alternated with the high

yields make the average for the period 1930-36 only 12.63 bags per acre as compared with 13.61 bags per acre for the previous six-year period.

It was noted above that in System D. the yield of the maize crops which immediately follow the application of farmyard manure are not much heavier than those which follow the bean-hay crop, and it was assumed that the lasting effect of the kraal manure was partially responsible for those results. This theory finds support by comparison of the yields recorded in System F. and H. In System F. the yields of the plots to which farmyard manure was directly applied totalled 155.4 bags per acre during the ten-year period 1926-36, while in System H. the yields of the plots following green-manure ploughed under totalled 170.2 bags per acre during the same period. This is roughly $1\frac{1}{2}$ bags per acre per annum in favour of the green-manure combined with phosphatic fertiliser. The average yield, however, of all the plots in the respective rotations is roughly $1\frac{1}{2}$ bags per acre per annum in favour of System F. It is clearly apparent therefore that the beneficial effect of the farmyard manure is spread over a longer period than that of the green manure, and the total benefit conferred by an 8-ton per acre dressing exceeds that of a single green-manure crop plus 200 lbs. per acre of phosphatic fertiliser.

NEW ROTATIONAL SYSTEMS.

In the season 1926-27 two new rotational systems were laid down which have been designated Systems M. and O. respectively.

System M.—This is a four-course rotation in which the sequence of the crops is:—Maize+200 lbs. per acre of superphosphate; ground nuts and sunflowers; maize+200 lbs. per acre of bone and superphosphate; green-manure. Hence one-half of the land is sown to maize, one-eighth to sunflowers and another eighth to ground nuts, and one-quarter is green-manured. In the following tabulation the yields of the various plots are expressed in bags per acre, a "bag" of maize being 200 lbs., and a "bag" of ground nuts 65 lbs.

Seasons and Yields of Maize in Bags per Acre.

	1935-36.	1934-35.	1933-34.	1932-33.	1931-32.	1926-27.	Average maize yield 1926-36
Plot A... ...	*14.90	G.M.	*13.75	N14.00	17.20	G.M.	13.12
Plot B... ...	G.M.	*5.55	N14.30	10.15	G.M.	*15.15	10.92
Plot C... ...	*12.50	N8.8	12.60	G.M.	*15.05	N21.0	13.42
Plot D... ...	N15.70	*7.95	G.M.	*8.05	N11.0	12.6	11.12
Average maize yield	13.70	6.75	13.17	9.10	16.13	13.88	12.15

*Denotes the application of fertiliser.

G.M.—Denotes the application of green manure.

N.—Denotes the position of the ground nuts in the rotation.

Prior to the season 1934-35 only one dressing of fertiliser was provided during each four-year period, but it was found that the crop yields were steadily decreasing and, commencing in the season 1934-35 a second dressing of fertiliser was added. The average maize yield of 13.70 bags per acre recorded this season is lower than that obtained on System H., and this indicates that the full effect of the additional fertiliser is not yet apparent. Nevertheless it may be claimed that the downward trend in the cropping ability of this land has been largely averted, because the yield noted is as high as it was in the season 1926-27 when the trials commenced. These results serve as a warning to show that farmers who grow cash crops only should feed their soils with at least 400 lbs. of phosphatic fertiliser in addition to an application of green manure or the equivalent in other forms of humus and phosphate during every period of four years, in order that the cropping power of the land may be maintained at a moderately high level.

System O.—The order of rotation is:—Maize fertilised with 200 lbs. per acre of bone and superphosphate; sweet potatoes; maize which receives a dressing of 8 tons per acre of farmyard manure; hay crops. This system is typical of a rotation suitable for dairymen or others who prefer to feed a large proportion of their crops to live stock. In practice it would probably be found necessary to make alterations to meet individual requirements, such as altering the proportion of maize to other crops, leaving the sweet potatoes down for two years, or reducing the amount of land under sweet potatoes, and growing pumpkins and melons instead. Whatever the

details of the adopted system may be, if the principles on which this rotation is based are adhered to, similar results could be expected.

In the tabulation below are shown the acre-yields of maize in bags of 200 lbs. and of bean hay and sweet potatoes in tons.

Seasons and Yields in Bags (or Tons) per Acre.

	1935-36.	1934-35.	1933-34.	1932-33.	1931-32.	1926-27	Average maize yield 1926-35
Plot F... ...	*19.32	H3.8	†19.18	P3.6	*18.55	H1.1	17.83
Plot G... ...	H1.4	†11.58	P5.5	*9.10	H1.2	19.65	15.08
Plot H... ...	†17.78	P5.65	*20.80	H.056	†20.25	P6.1	18.24
Plot J... ...	P3.70	*9.84	H2.5	*9.95	P12.40	*16.45	15.40
Average of maize plots	18.55	10.71	19.99	9.53	19.40	18.05	16.64

*Denotes the application of fertiliser.
†Denotes the application of farmyard manure.
P.—Denotes the position of the sweet potatoes in the rotation.
H.—Denotes the position of the bean hay crop.

The high yields obtained in this system show that considerable benefit is to be derived from using as wide a range of crops as can be advantageously employed. By comparing the results obtained in Systems F. and O. in which the same amounts of farmyard manure and fertiliser are used, it is found that during the five-year period 1931-35 the average yield of maize in System F. was 14.4 bags per acre as against 15.64 bags per acre in System O. The average yield of sweet potato tubers during the same period is 6.17 tons per acre and the feed value of these may be considered to be equal to 15 bags of maize. The value of the sweet potato tops would almost balance that of the Sudan grass, leaving nearly the whole of the bean hay crop in favour of System O.

METHOD OF APPLICATION OF FERTILISER TRIALS.

Method of Application of Fertiliser Trials.—These investigations were undertaken at the request of the Maize Association with the object of ascertaining whether the manner in which fertiliser is applied to the land is likely to affect the yield of the maize crop. Fertiliser is applied in four different ways, namely:—

(1) Broadcast shortly before planting time and harrowed in.
(2) Broadcast during winter and ploughed in.
(3) In holes in check rows shortly before the seed is planted.
(4) In drills at the time of sowing the seed.

Previous trials, conducted over a period of three years, had shown that, with the exception of method No. 1 the various other methods of applying fertiliser were equally efficacious. For those trials a different site was chosen each year. Other experiments had shown that phosphatic fertilisers leave a residue which may be utilised by the following crop, and for this reason in the season 1931-32 it was decided that future trials in this series should continue on the same land for a number of years, each method of applying the fertiliser being practised on its particular group of plots in order to ascertain whether the fertiliser which is not used by the crop during the first season would become available at a later date.

The fertiliser dressing is at the rate of 150 lbs. per acre and the various methods of applying it are replicated five times. During the season 1933-34 this land was green-manured and it is proposed to repeat this practice at intervals of three years.

The following table records the yield of maize in lbs. per one-twentieth acre plot. In the first column under each heading are the combined yields for the three seasons 1931-32 to 1934-35, while the second column shows the yield for the season under review.

Yields of Maize in lbs. per Plot of one-twentieth of an acre.

	Harrowed in		Ploughed in		Holes.		Drills.	
	1931-5.	1935-6.	1931-5.	1935-6.	1931-5.	1935-6.	1931-5.	1935-6.
	379	175	434	173	366	170	431	177
	318	155	420	144	387	152	367	153
	344	164	409	163	304	163	486	161
	261	155	350	149	370	161	333	160
	348	151	327	130	373	140	307	132
	1650	800	1940	759	1800	786	1924	783
Total of 4 crops	2450		2699		2586		2707	
Average yield in bags per acre	12.25		1349		12.93		13.53	

This season's results are contrary to those of the previous six years, for instead of the plots on which the fertiliser was ploughed under giving the highest yield, they have receded to the lowest place and the "harrowed in" plots have taken their place at the top of the list. The crop on the latter series of plots appears to have made better use of the fertiliser this season than in previous years, presumably because the favourable climatic conditions enable the plants to make use of some of the residue of previous applications as well as that which was applied in the season under review. Comparison of the total yields of the four crops grown since this series commenced shows that there is a substantial margin in favour of ploughing under the fertiliser or applying it in the drills.

Comparison of the Effect on Succeeding Crops of Maize, of Ploughing under Green Sunnhemp versus **Burning the Mature Crop of Sunnhemp on the Land.**—A number of farmers have reported that their crops of maize following the burning of a mature crop of sunnhemp have grown more luxuriantly than adjacent crops following the ploughing under of the crop for green manure, which is the usual practice. Various reasons for these results have been put forward, such as that the burning may cause the temporary increase of nitrogen-fixing bacteria in the soil as shown by Russel and others at Rothamsted, or liberate essential nutrients which would otherwise remain unavailable to succeeding crops, and so stimulate the growth of the young maize plants enable them to maintain their lead over the crop on the green-manured land.

Series No. 1.—Investigations were commenced in the season 1930-31 when a crop of sunnhemp was treated in three different ways, namely:—

(*a*) ploughed under for green manure when the first pods formed;

(*b*) mature crop burned on the land;

(*c*) ash returned to the land after the mature stalks had been burned elsewhere, to avoid the partial sterilising effect (if any) of burning the crop on the land.

Each method of treating the sunnhemp was replicated ten times.

The land was cropped with maize for three seasons, but during that period the returns failed to reveal any definite advantage in favour of either of the methods of treatment. In the season 1934-35 sunnhemp was again grown on this land and the previous methods of treatment were again applied to the same plots as before, excepting that on the "C" plots the green sunnhemp was sprinkled with rock phosphate at the time it was ploughed under with a view to ascertaining the effects of this method of treatment. During the season under review the whole of this land was cropped to maize with the results shown in the following tabulation.

Yields of Maize in lbs. per Plot of 1/30th Acre.

	Green Sunnhemp ploughed under in the usual way.	Green Sunnhemp ploughed under after dusting with rock phosphate.	Mature Sunnhemp burnt on the land.
	177	167	122
	181	181	113
	167	186	125
	181	173	112
	163	170	131
	174	164	115
	148	158	105
	139	142	118
	135	138	97
	144	131	97
	1,609	1,610	1,135
Yields in bags per acre	24.14	24.15	17.03

These results show a very definite decrease of approximately 30% in the yields of the plots on which the sunnhemp was burned. The reason for this season's results being so unfavourable to the practice of burning is not easy to explain, but during the growing season it was noticed that the maize plants on these plots were unable to resist the droughty conditions which prevailed at the commencement of the season to the same extent as those on the plots which were green-

manured, no doubt owing to the forced growth of the maize which has always been found to result after burning the mature sunnhemp crop in these experiments. No benefit accrued from dusting the green material with phosphate at the time it was ploughed under. Rock phosphate of the same quantity and quality to that used on the green material of the "C" plots at the time of ploughing it under was subsequently applied on the "A" and "B" plots shortly before the maize crop was planted.

Series No. 2.—In order to further investigate the effect of ploughing under the green-manure crop *versus* burning the mature crop on the land, a second series of plots were treated in the manner described for Senies No. 1 in the season 1933-34, and have been cropped with maize during the two subsequent seasons. The results are shown in the tabulation given below.

Yields of Maize in lbs. per Plot of 1/30th Acre.

	Green Sunnhemp ploughed under in the usual way. Season 1934-35.	Season 1935-36.	Green Sunnhemp ploughed under after dusting with rock phosphate. Season 1934-35.	Season 1935-36.	Mature Sunnhemp burnt on the land. Season 1934-35.	Season 1935-36.
	39	88	39	85	53	91
	38	74	42	71	57	94
	55	90	48	95	68	91
	60	105	70	95	47	97
	57	104	67	109	69	92
	31	101	92	123	89	118
	79	119	109	111	42	92
	72	112	55	103	91	118
	83	144	87	156	54	115
	83	156	85	140	79	124
	597	1,093	694	1,088	649	1,032
Totals for two years	1,690		1,782		1,681	
Yields in bags per acre (two years)	25.35		26.73		25.32	

These returns corroborate those obtained in Series No. 1 during the first period in showing that equally good results may follow either ploughing under the green crop or burning the mature top growth, because, apparently a large proportion of the benefit conferred by the green manure crop is derived from the root system. In this series the total yield of all the plots on which the fertiliser dressing was distributed over the green material at the time of ploughing it under was considerably heavier than the total yields for the other treatments. Statistical analysis of these results shows that the observed differences are due to experimental errors rather than the method of treating the sunnhemp. Further, in Series No. 1 the yields obtained where the green manure was ploughed under without phosphate did not differ appreciably from those of the plots on which the sunnhemp was dusted with phosphate at the time it was ploughed under. It may be concluded, therefore, that no advantage is to be gained by this practice.

Sunnhemp: Rate of Seeding Trials.—The comparatively large quantity of seed produced by the "Somerset" variety of sunnhemp has made it possible to sow this crop at a considerably lower cost than was formerly possible, and a number of farmers have expressed their intention of growing it for hay for use as cattle fodder during the winter months. The question has arisen therefore as to the quantity of seed which must be sown in order that the largest yield of fodder of high quality may be produced, and in order to obtain information on this subject experimental sowings, using 20 lbs., 40 lbs., 60 lbs., and 80 lbs. per acre were made. The seed was sown with a grain drill in rows six inches apart on the 6th December, 1935, each rate of seeding being replicated on five plots. The seed germinated well, but the growth of the crop was retarded somewhat by the drought conditions which prevailed. The dense stand of plants resulting from the heavier seedings caused the stems to be finer on those plots, but when the crop was cut on the 16th March, 1936, the total weight of fodder was found to be only slightly more than that obtained from the lightest rate of seeding.

The fodder yields were as follows:—

Rate of Seeding: lbs. per acre.	Yield of dry Fodder: lbs. per acre.
20	5,472
40	5,910
60	5,958
80	6,012

Although these returns show a difference of only quarter of a ton of hay per acre in favour of the heaviest rate of seeding, it must be remembered that in these trials the seed was drilled in, and for that reason a more complete germination as well as a more even stand was probably obtained than would result from a similar quantity of seed sown broadcast under the usual field conditions. For this reason it is probable that 40 lbs. to 60 lbs. of seed of the "Somerset" variety will be found necessary under ordinary field conditions when it is to be sown broadcast, in order that a stand which is dense enough to suppress weed growth and induce the formation of fine stems with a large proportion of leaves may be assured. The crop should not be allowed to become too old before it is mown, for if this point is neglected a large proportion of indigestible fibre will form in the stems and its value as fodder will be considerably reduced. Ten to twelve weeks from the germination of the seed appears to be the most suitable stage in the growth of the sunnhemp fodder for its conversion into hay or silage.

Pyrethrum.—The results of previous experiments with this crop have shown that, although fairly satisfactory yields were obtained on irrigated land, a large number of plants which did not produce flowers when the crop was grown under dry land conditions indicated that the strain we had was not suited to our climate. A few plants appeared to be superior to the others, and from these small plots have been established. One of these strains appears to be definitely superior to the original stock. Under dry land conditions only about 25 per cent. of the plants in the original stock produced flowers, but in the selected stock there are 60 per cent. of flowering plants in the

dry land plots and 90 per cent. in the plots grown under irrigation. Further selective work is being carried out, the outcome of which, it is hoped, will be the establishment of strains which will produce heavy crops of flowers comparable with those grown on a commercial scale in other countries. Meanwhile farmers who wish to try the crop are advised to grow it under irrigation or on drained vlei land which retains a certain amount of moisture for the greater part of the season, because the strains we have at present are not fully capable of withstanding the rigour of our long winter and spring drought.

WITCHWEED.

NEW LIGHT ON THE MEANS BY WHICH IT IS SPREAD.

By H. H. Farquhar.

In the following article Mr. Farquhar makes an important contribution to our knowledge of the means by which the seed of witchweed is spread. Although it has long been realised that stock are one of the carriers of the parasite from infested veld to maize fields and vice versa, the extent to which they may spread it has not previously been appreciated. The results of Mr. Farquhar's careful experiments and observations make it clear that not only must the parasite be controlled in our cultivated fields, but also in the veld.

In the new light shed on the matter in this article can be seen an explanation for the only partial success attained in some cases by the standard means of control of the parasite in the cultivated fields.

Mr. Farquhar is an employee of the British South Africa Company and manages a section of their Mazoe Citrus Estate, and it is desirable to point out that the views he expresses are his own and not necessarily those of his employers.—S.D.T.

It has been most interesting and instructive to read in the *Rhodesia Agricultural Journal* of the experiences of farmers in the control and eradication of witchweed.

I have been combatting this pest in Rhodesia for fifteen years and have come to certain conclusions which may be of interest. The general contention seems to be that storm water and wind are the chief means of spreading witchweed. Another source of trouble is practically overlooked.

In the articles published by farmers, Messrs. E. S. White and A. S. Laurie, refer to the possibility of cattle carrying seed. Mr. Laurie mentions that this would be passed through

the bowels. I will go so far as to state that cattle are the chief means of spreading witchweed seed. In making this statement I fully realise that I will have to prove my contention.

My observations in this country have extended over 15 years. Previously I had seen witchweed in the Ladysmith district of Natal. It has been noticeable that witchweed spreads more rapidly in Rhodesia than in Natal. I have come to the conclusion that the pest in Natal was killed off early by heavy frosts; ploughing was not usually done until after the first rains and not in April, May and June, as in this country, between stooked maize. If the stooked maize lands are infested the cattle pick up plants and seed and distribute them wholesale in the lands and veld. Maize lands are reaped and cattle are grazing the stalks by June. Here again, if the fields are infested, the same process goes on. It has been mentioned in your *Journal* by Mr. Timson that he has seen witchweed growing in maize lands as late as mid-June in the Mazoe Valley. To a certain extent seed may be spread by wind and stormwater, but in comparison with that spread by animals these sources are negligible. I have left a patch of witchweed on the side of a hill to see how far it would spread. The distance covered in a few years has not been great. The patch was on the windward side of the hill. Stormwater drains are most essential, but they will not prevent the spreading of seed to any extent. Some eight years ago I asked one of your Departmental officials for advice to stop the spread of witchweed and I was told to protect the lands with stormwater drains. As a matter of fact the lands had been fully protected for several years.

In this instance a very heavily infested field (No. 1) had been stooked and ploughed in May. The field was so bad that less than two bags per acre was harvested. To my dismay a portion of the field next ploughed, adjoining No. 1, became very heavily infested the following season. Both fields were protected by stormwater drains, it was impossible for seed to be carried in this way and ploughing was done before high winds had commenced. No. 2 was on the windward side. The most remarkable thing about this infestation was that it only covered a portion of the field. This portion had been ploughed

first after moving from No. 1. No. 2 field had had witchweed removed for several years and was practically free of it. It is common knowledge that oxen while working will pick up grass, weeds and maize leaves in stooked lands and there is no reason to suppose that witchweed plants will be avoided. I do not wish to infer that cattle will deliberately look for witchweed; some may be old soldiers and know a good tit-bit.

The chlorine content of witchweed is fairly high and this alone would be an attraction. Natives from the North say that when they are short of salt they extract something from the plants that is a substitute.

After breaking up new land it became heavily infested in a year or so. At the time of breaking up only a few plants were growing, but in spite of continually cleaning the lands after maize was planted the infestation increased. The surrounding veld, where working oxen were grazing, was found to be heavily infested, and this seemed the chief cause of infestation. Also, that in every field that had been stooked an increase in witchweed was noticed the following season. This apparently came from two sources, the field itself during ploughing operations and from the infested veld. I decided to take the cleaning up of the veld in hand and to stop stooking maize. During the first few years of this experiment a remarkable change took place and maize lands were easier to control and expenditure was lower. No oxen were allowed into cultivated lands if they came from infested veld. They were grazed on clean veld for a few days before being used.

Witchweed has been found growing in the veld in the first week in January. It must surely be realised that oxen grazing on infested veld, used for cultivation and ploughing in cover crops, must carry the seed and a fresh infestation is probably started the same season. Mr. Timson has stated that seed from witchweed will not give a good germination the same season. I have actually germinated witchweed in March that has been pulled up in January, but the germination has not been good. Still, there is no reason to suppose that seed carried by cattle into a maize field during cultivation will not germinate to a small extent that season. The dung passed would give the host plant quite a good kick off, and also the witchweed itself.

A few years after stooking had ceased and the cleaning up of the veld had been continued and the maize lands had improved, I received a very rude shock. Infestation suddenly appeared in fields which had never been badly infested; in fact, at this time they were considered to be almost free of witchweed. The fresh infestation was a complete mystery for several weeks. The most remarkable thing was that it was in strips extending, in some instances, from one end of the field to the other. These strips appeared at almost regular intervals. The veld in this area was almost free from witchweed; the fields had not been stooked for several years, and a few stray plants could not have caused this serious outbreak. Suddenly the reason was made obvious, as the previous season these fields had been cut for silage for the adjoining farm. On the adjoining farm the maize for silage had practically failed from drought and witchweed and the veld was also heavily infested at the time. Oxen used for carting the maize were brought straight to my clean lands from heavily infested fields. The strips of witchweed defined the roadway used by the wagons. A close examination of these strips showed that by the appearance of the witchweed in certain places the turning of a loaded wagon could be traced. This fully convinced me that the infestation had been brought in by the oxen used in the wagons. I decided to test my theory and if successful it would prove to my satisfaction that oxen were the carriers of witchweed seed.

Two oxen were placed in a pen and fed on grass free of witchweed. They were kept in until the experiment was completed, even being watered in the pen. The first three days they were fed on grass only. The dung was collected, dried and stored. This was called "A." On the fourth day and the two following days the oxen received a small handful of witchweed plants between them, about fifteen to twenty each. The dung passed after eating the witchweed was collected for four days, dried and stored and called "B." The object in collecting the "A" dung was to verify that no witchweed seed had been brought in from the veld. The plants fed came direct from the maize fields in all stages of development, in flower, a few had mature pods, but mostly green ones, and were were slightly wilted when fed. The oxen just gave a sniff at the plants and ate them readily. One of the natives remarked

at the time that the oxen ate them like forage (lucerne). As it was too late in the season to test the dung for germination of witchweed plants it was stored until November of that year.

Six boxes of soil were taken and three received a good dressing of dung from "A" and three from "B." Maize was planted and the boxes put outside. Germination of maize started by rainfall. By the end of December witchweed made its appearance in the boxes dressed with "B" dung. In the middle of January these three boxes were a mass of witchweed plants, the maize was stunted; in fact, made no appreciable growth at all. Boxes with "A" dung gave a negative result, no witchweed appearing. "B" boxes gave an average of 38 plants per box, one box going as high as 45 plants. A further test of "B" dung was made and gave an average of 32 plants per box, this gives an average of 35 for the two tests. Roughly, two per cent. of the dung was used, this would then give a possible 1,750 plants from two oxen fed on from 15 to 20 plants for three days. I think it can be left to the imagination what the position would be with, say, four or six spans ploughing in a badly infested maize land with each ox picking up about ten plants daily.

It was my intention to carry these experiments further before giving these details, but owing to altered conditions in my farming operations during the past few years I find it impossible to do so. I wish it to be clearly understood that I do not condemn stooking of maize, but first see that your land is free from witchweed before sending oxen in to plough, or cattle to graze in infested maize land.

Witchweed in the veld is comparatively easy to eradicate. It can be handled as the root system is not so extensive as in cultivated lands. It takes four to six years to eradicate, it depends on the infestation. Hand pulling in maize lands I have found useless, the root system is left behind; dig it out by hand, shallow digging is useless, the roots must all be dug out. Some maize roots may be damaged, but witchweed will do more harm than the cutting of a few roots. The plants next to the maize plant have to be hand pulled.

I have seen farmers throw witchweed on the edge of the field; surely this is looking for trouble. A hole in the ground is the best place.

One hears that sunnhemp used as a cover crop causes an increase in witchweed the following season. Can any farmer state that when his oxen were ploughing in the crop they were not carrying seed? I say definitely No! Some years ago a farmer told me that sunnhemp was useless, that he had ploughed in a cover crop and the following year the field was a mass of the pest. The veld, he informed me, near the field, was almost as bad. Can one wonder?

Land that gave less than two bags per acre I have cover-cropped with sunnhemp and have reaped twelve bags the following season. This was followed by sunnhemp for seed and maize reaped the next three years was 15, 12 and 8 bags per acre respectively. This instance refers to field No. 1 mentioned previously in this article. I think there is a lot to learn as to when to plant and plough in cover crops to get the maximum and permanent benefit from such crops. It would be most interesting to have facts on this with the effect on witchweed the following season. I have some information, but unfortunately it is incomplete. I fully realise that sunnhemp is not a host, but is it not possible that use might be made of this excellent plant to destroy the witchweed seed in the ground? The returns from field No. 1 were due entirely to sunnhemp, neither year showed any great increase in witchweed that could not be coped with by hand; in fact, after the cover crop the witchweed was practically negligible. My conclusions were that the time of planting and ploughing in had a tremendous influence on the reduction of witchweed. Of course, seasonal conditions would, perhaps, come first. I am aware that it has been stated that witchweed seed will remain in the ground for several years and germinate as soon as a host plant is available. My contention is that soil conditions have to be favourable for seed to remain in the ground for a considerable period. Is it not possible to plant something in badly infested ground to make those conditions for the existence of seed unfavourable?

Trap cropping I have not given a trial, as my fear has always been that the ground would not be suitable for ploughing at the critical time; that is that it would be too wet.

During a conversation with a farmer friend a most interesting point was brought to light on witchweed. He told me he had never seen this growing in the native maize in his

compound. As far as I can recollect I have never seen it either. This is a small point, but usually no cattle go near the compounds when maize is growing. I should like to see some proper field experiments carried out on a fairly big scale on cultivated land that is heavily infested. I do not think that experiments carried out on small plots would be of any use. A block of 50 acres or so would be ideal. This would have to be guaranteed for use until experiments were completed, say, in about five years or more. A small committee should be formed with an Agricultural Department official as Chairman to collect all information and draw up a scheme of experiment and control this entirely.

Editorial Note.—The importance of Mr. Farquhar's investigations into the agency of cattle in spreading witchweed from the veld to our cultivated lands will be at once appreciated by the farmer who has had experience of this parasite.

However, at a later date, it is proposed to review in this *Journal* the more important ways in which our present methods of control of the parasite may require modification in view of the results of his experiment. It is, for instance, quite clear that in future farmers must turn their attention to the original source of infestation of their cultivated lands, namely, the virgin veld on which their stock graze. Fortunately, the parasite appears on the veld before the time it requires cultivation in the maize fields, and it can be controlled there by simple hand-picking. Fortunately, too, except under certain specialised conditions, it is only found sparsely scattered through the veld, and it is seldom that it makes vigorous growth there, or re-growth after hand-picking. The areas on which contour ridges spill stormwater will require particular attention, and hollows where the natural drainage has led to a certain concentration of the parasite.

It would appear that farmers should at once endeavour to clear a portion of their veld from witchweed in order to supply clean grazing for their working oxen when the latter are being employed on cultivation and other work on the cultivated land during the witchweed season. Other aspects of the matter will be discussed in an article to be published at a later date in this Journal.

DIVISION of ENTOMOLOGY, ANNUAL REPORT FOR YEAR 1936.

By R. W. Jack, Chief Entomologist.

AGRICULTURAL.

(1) **Locusts.**—The Red Locust (*Nomadacris septemfasciata*, Serv.) has been present in swarm formation in the Colony through the year.

The first reports of egg-laying during 1935-36 season were received in January, 1936, but the discovery of second stage hoppers during that month in the Mtobo district shows that some eggs must have been deposited early in December, 1935.

Hoppers appeared in four districts during February and the last hoppers were destroyed or developed wings in early June.

The following districts suffered hopper outbreaks on a greater or lesser scale, namely:—Darwin, Mazoe, Salisbury, Lomagundi, Mrewa, Mtoko, Makoni, Charter, Hartley, Gwelo, Selukwe, Victoria, Belingwe, Chibi and Nyamandhlovu.

What appears to have been the last swarm of the 1935 generation was reported in the Gwelo district on March 2nd, whilst the earliest fliers of the 1936 generation appeared in the Eastern districts in mid-May, having apparently come from Portuguese East Africa.

Whilst swarms have been continuously present, no reports of egg-laying in the Colony had been received to the end of December, 1936.

Campaign.—The campaign against hoppers extended from February to the end of May, but only three localities were involved before March. In most districts the outbreaks were effectively dealt with in all accessible situations. Difficulty was, however, experienced in one district due to concealment of outbreaks by the local farmers and definite refusal to take action on the part of several, necessitating prosecutions. Such

occurrences are greatly to be deplored, but there is without doubt considerable reluctance in the case of certain stock farmers to use the poison on their farms.

Experiments with a poisoned bait, developed in the Union of South Africa, gave promising results. This bait, which consists of maize meal, molasses and arsenite of soda, is judged in the Union to be less dangerous to stock than spraying on account of the lower quantity of poison used to the acre. Further experience is, however, needed as to the results of its use in possibly careless hands. The bait is, in any case, particularly useful against hoppers which hatch out amongst growing crops, where spraying is very difficult, if not impossible.

Enemies and Diseases.—The locusts have been notably free from disease during the year, and no great activity of parasites has been recorded. Birds have, however, been observed following the swarms in great numbers on various occasions.

In spite of all natural agents of destruction some very large swarms were present in the Colony up to the end of the year.

Prospects.—Whilst it appears that eggs are likely to be laid over limited areas in the Colony during the present season, there has as yet been no definite pre-breeding invasions from north of the Zambesi River, such as has preceded heavy hopper outbreaks in the past, and on the whole the prospects for the present season are reasonably favourable.

There are ample stores of pumps and poison on hand to cope with any developments.

(2) **Pests of Stored Products.**—(*a*) *Tobacco.*—The position regarding our two main pests of stored tobacco, *viz.*, the Stored Tobacco Worm (*Ephestia elutella,* Hubn.) and the Tobacco Beetle (*Lasioderma serricorne,* Fab.) remains substantially the same as during the past two or three years. This satisfactory state of affairs is attributed to proper hygiene and complete and early disposal of crops.

Adults, but not larvæ, of L. *serricorne* were found in fire-cured tobacco, but were not believed to have developed in this medium.

(*b*) *Maize.*—The pest on which attention is being focussed is the weevil, *Calandra oryzæ*, L. Investigations show that field infestation is higher on premises where maize is stored for grinding as required on the farm, than on premises from which the grain is sent to central mills early in the season for storage, to be returned as meal when needed. The problem of the best treatment for shelling dumps, from which field infestation may arise, has not yet been investigated. Environmental conditions in a maize stack are being studied with a view to devising modification of storage practice to effect control of the weevil. Interesting and possibly economic results are, so far, indicated.

(3) **Pests of Growing Tobacco.**—(*a*) *Root Gallworm* (*Heterodera marioni*, Goodey).—The increasing importance of this pest to the tobacco industry is now realised, and for this reason an officer of the Tobacco Research Station at Trelawney is carrying out investigations.

(*b*) *Tobacco White Fly* (*Bemisia rhodesiænsis*, Corbett).—This pest was not common as a pest of tobacco, being recorded only on five farms in four districts of Mashonaland.

(*c*) *Sand Crickets* (*Brachytrypes membranaceus*, Dr.).—Field tests with a moistened mixture of barium fluosilicate and maize meal gave promising results in the Salisbury South area where this cricket is a serious pest. A mortality of over 90 per cent. was reported.

(*d*) *Others Pests of Tobacco.*—A beetle, *Protostrophus*, sp., caused considerable damage to newly-transplanted tobacco during November in the Salisbury district. Cutworms, *Euxoa segetum*, Schiff, were reported as injurious to plants in the fields during February.

(4) **Pests of Citrus.**—The following has been kindly contributed by the B.S.A. Company's Entomologist at Mazoe:—

Serious damage was done by the attack of the Cotton Bollworm (*Heliothis obsoleta*, F.) and the loss will be almost as much as in 1934. The appearance of the attack did not indicate that such serious consequences would follow, but, unlike previous years, the initial flight of moths was followed by a second flight subsequent to rainfall at the end of August. The protracted summer which enabled extra summer generation to develop was also a contributory cause.

The Citrus Aphis (*A. tavaresi*, Del. G.) accounted for a little loss, but was relatively unimportant.

The Citrus Thrip (*Scirtothrips aurantii*, Faure) attack was the mildest experienced for many years and a single application of colloidal-sulphur-lime sulphur spray was sufficient for control purposes.

Although Soft Scale (*Lecanium hesperidum*, L.) has caused no trouble during the past few years, precautionary measures will be necessary during the coming year.

Other citrus pests have been of no importance and there was no damage done by Red Locust.

(5) **Pests of Fruit, other than Citrus.**—The White Mango Scale (*Aulacaspis cinnamoni*, Newst.) was found in another garden in Salisbury on a large mango tree. The Tingid, *Teleonema australis*, Dist., was very injurious to the foliage of cultivated olives in the Bulawayo district.

(6) **Cotton Pests.**—The following has been kindly contributed by the Cotton Specialist:—

American Bollworm (*H. obsoleta*, F.) damage on cotton was probably slightly less than for the last year or two, although in some areas crops were fairly heavily attacked. By regulating the time of planting of cotton and other crops, some alleviation of attack may be obtained.

Sudan Bollworm (*Diparopsis castanea*, Hmp.) damage was slightly heavier than in the previous year. Investigations show the importance of prohibiting ratooning, and the leaving of cotton crops "stand-over" from one season to another, in limiting the spread of Sudan bollworm.

Stainer (*Dysdercus spp.*) damage generally was heavier than in the previous year. Serious damage in a district appears to be correlated with the presence of fairly abundant host plants.

Jassid (*Empoasca fascialis*, Jac.).—Throughout most of the country jassid damage was slight. But in one or two isolated areas, especially on a part of the Cotton Station, Gatooma, jassid attack was abnormally heavy. This emphasises the importance of the new more highly resistant strains of cotton which are being bred up at Gatooma.

(7) **Pests of Growing Maize.**—*Streak Disease of Maize.*—Investigations were carried out in the Umtali district in January. A species of jassid (*Cicadulina mbila*, Naudé), which was found near Odzi in "streak" infected fields, was incriminated as a vector of this virus disease by Dr. Wickens, of the Plant Pathological Branch. *Cicadulina zeæ*, Naudé, was found in association with *C. mbila*, but no transmission was effected in experiments at the laboratories.

The snout beetle, *Tanymecus destructor*, Mshl., was abundant in November and December in newly sown maize lands. Poison baiting as recommended by this Branch has been frequently adopted.

The surface beetles, *Emyon tristis*, Fhs., and *Gonocephalum simplex*, F., were reported as injurious to uncovered maize grain, and to maize seedlings, in the Salisbury district during December. Infestation of volunteer maize by the stalk borer (*Busseola fusca*, Full.) was noted in mid-December in the Salisbury district, but the infestation of maize generally in Mashonaland was not serious.

(8) **Pests of Other Crops.**—Wheat was attacked by *Cirphis loreyi*, Dup. (Noctuidæ) in June and July in the Shamva district. The caterpillars were lightly parasitised by a Tachnid fly, *Linnæmyia angulicornis*, Speis.

Seedling cowpeas at the Agricultural Experimental Station, Salisbury, were attacked by the snout beetles, *Systates exaptus*, Mshl., and *Tanymecus destructor*, Mshl., in December.

(9) **Pests of Forest and Shade Trees.**—In the Gwelo district, a long-horned beetle, *Phoracantha semipunctata*, F. (Cerambycidæ), caused extensive damage to established plantations of Eucalyptus, *E. maideni* and *E. paniculata*, being severely attacked. The borer beetle, *Apate monachus*, F. (Bostrychidæ) is a pest of a shade tree, *Trichilia emetica*, Vahl. (Meliaceæ) in the Salisbury district.

(10) **Sunnhemp**.—In the seedling and young stages was seriously attacked by a beetle, *Exora discoidalis*, Jac. (Chrysomelidæ) in several localities near Salisbury during November

and December. The crop was also injured by the beetles, *Systates exaptus*, Mshl., and *Mimaulus testudo*, Fhs. (Curculionidæ).

An attack by a beetle, *Exora sheppardi*, Jac.,* was reported from a farm in the Umvukwes area in early December.

(11) **Pests of Vegetables and Garden Plants.**—Bagrada bugs (*B. hilaris*, Burm.) did a considerable amount of damage to cabbages, turnips and other crucifers during July and August in several localities. The web-worm (*Hellula undalis*, F.) was a pest of cabbages in August in the Salisbury district. A small moth, *Crocidolomia binatalis*, Zett. (Pyralidæ) injured cabbages and cauliflowers in the Marandellas area during February.

The first flowering shoots of gladiolus were severely injured in November by a Sphegid wasp, *Crabro* (*Dasyproctus*) *bipunctatus*, Lep., which makes its nest in the stems. A thrip (undetermined) was a pest of gladiolus in December and January in the Umtali, Salisbury and Gwelo districts. A Coreid bug, *Anthocoris fusciculus*, F., caused wilting of the stems of Moonflower (Datura) in March in the Salisbury district.

A Dodonæa hedge was severely infested with a lac insect, *Tachardina affluens*, Brain, in the Bulawayo district.

(12) **Miscellaneous Insect Records.**—The following insects and their host plants are worthy of record. Many of the records are the results of observations made during the year, and a few others, of earlier observations, were made when no authentic names were available:—

(1) The leaf-eating beetle, *Phædonia areata*, F., (Chrysomelidæ) which defoliated an experimental plot of a cover-crop, *Indigofera endecaphylla*, at Salisbury.

(2) The mite, *Rhizoglyphus echinopus*, F. & R., which infested the bulb of *Lilium longifolia* in July, 1935.

(3) The Bruchids, *Bruchus centromaculatus*, All., *Pachymerus cassiæ*, Gyl. and *P. pallidus*, Ol., which infests the seed pods of Cassia.

(4) The Bruchid, *Bruchus subuiformis*, Pic., which infests the seeds of Albizzia, sp.

*Identified by the Imperial Institute of Entomology as *E. apicipenne*, Jac.

(5) The Bruchid, *Bruchus rhodesianus*, Pic., which infested the seeds of dhal (*Cajonus indicus*), imported from India.

(6) The Membracid bug, *Oxyrachis gibbulus*, Mel., whose host plant is *Albizzia antunesiana* (Leguminosæ).

MEDICAL AND VETERINARY.

The following report on the tsetse fly operations has been submitted by Mr. J. K. Chorley, who is immediately in charge of this undertaking. I append a few remarks as follows:—

The continued success of the game reduction cordon in keeping the fly confined to country which is more or less useless for settlement, is a matter for satisfaction.

In addition, whilst reclamation of country from fly is not the primary object of these operations, substantial additional areas have been freed from the pest in two sections during the year.

In the Gwaai-Shangani region the fly has once again been driven back to the northern side of the Shangani River, and although fly occurs rather further west to the north of the Shangani than it did in 1922, the position is now substantially the same as at the conclusion of the four years' operations which were commenced in 1919 and discontinued in 1922. At a conservative estimate two hundred and fifty square miles of country have been cleared of permanent fly in this section since 1931.

In the Hartley district (Gatooma section), the fly has continued to recede westwards and now occupies only a relatively narrow strip of country, some 12 miles wide at its widest point, on the eastern side of the Umniati River. It is interesting that a small area on the lower Nyabangwe (Yabongwe) River in which the fly survived after 1896 is included in the area now cleared of permanent fly.

The sections of Lomagundi, S.W., and Gatooma both deal with one large salient from the main fly area. It is possible to state that at the end of the year under review this salient had been shortened by about 20 miles and narrowed

by about 15 miles on either side. The area cleared of permanent fly in this salient is roughly 1,200 square miles. Adding the areas in other sections, as given in last year's report, and the two hundred and fifty square miles in the Gwaai-Shangani region, we obtain a total of over 2,500 square miles cleared of fly, not counting the Darwin district, where an area of about 400 square miles has been made more or less safe for cattle. The last-named area is not included in the total because, whilst cattle could not be kept there, the country was not actually infested with permanent fly, only occasional specimens being met with during the worst period.

The continued improvement of the position in the South Melsetter district, presumably the result of the border clearing against *Glossina pallidipes*, is also very encouraging, but the serious threat occasioned by the advance of *morsitans* through Portuguese Territory towards the Rhodesian border in the region of the low veld of the Sabi Valley is very disquieting.

Tsetse Fly Operations (J. K. Chorley).—It is pleasing to record that during the past year, as a result of the controlled operations against game, additional gains have to be recorded. In all areas, with the exception of the western portion of the Urungwe district, the fly has been eradicated over considerable areas covered by the operations, more land reclaimed and farming areas adjacent to the fly areas further protected from invasion by ranging or carried tsetse. No advances of fly have been recorded in any area where, owing to the country being doubtfully suitable for advance, it has not been considered necessary to operate for the present. The number of cases of animal trypanosomiasis diagnosed by the Director of Veterinary Research or by this Division during the year has been small, nineteen in all. Six of these cases are probably relapses. These cases were distributed as follows:—Four head of European-owned stock in the Sebungwe district, three in the Hartley district, three in the Wankie district, two in the Melsetter district and one in the Lomagundi district. Of native-owned stock, nine cases occurred in the Urungwe Native Reserve and two in the Doma area.

In consequence of this improvement it has been possible to reduce the total of paid native hunters and to close down four of the traffic cleansing stations in the Wankie district,

thus freeing the main tourist route to the Victoria Falls from all restrictions imposed on traffic by regulations under the Tsetse Fly Act.

Pursuant to the policy of reducing the open shooting areas, wherever they no longer serve a useful purpose in controlling tsetse, the open shooting areas in the Lomagundi, Darwin and Hartley districts have been abolished, and the open shooting area in the Wankie district considerably reduced. The closing of this latter area should greatly benefit the Wankie Game Reserve, where it is expected the larger antelope will now begin to increase.

In the southern fenced zone in the Doma area, approximately 1,400 head of native-owned stock have been introduced and two dipping tanks repaired and restored to commission. Whether it is a wise policy to introduce such large numbers of stock into this area has still to be seen. The cattle running close to the middle fence are within eight miles of an area where a few fly are known to persist and consequently these cattle are within the danger zone. Some cases of trypanosomiasis are almost certain to occur.

Certain developments under the "Land Apportionment Act, 1926," have been contemplated during the year which would have seriously interfered with the policy of this Division of creating, by the use of unpaid native hunters, game free zones along the edge of the fly front. As a result of representations made, it has been decided that those natives living on Crown lands on the edge of the fly areas shall, for the time being, be permitted to remain in occupation. The hut tax of those natives employed as unpaid hunters will in future be paid by this Division.

Two rather disquieting developments have been discovered during the year. The first is the discovery brought to light after a fly survey carried out by this Division in the Northern Mossurise District of Portuguese East Africa that the tsetse fly, *Glossina morsitans*, is slowly spreading west through the low veld and threatens, at some future date, to invade the low lying Sabi Valley at the southern end of the Melsetter district. The present Border clearing is designed to prevent the incursion of the thicket loving species, *G. pallidipes* and *G. brevi-*

palpis. It will be difficult to construct a clearing in the low veld which would be effective against *G. morsitans*. The matter is receiving consideration at the moment.

The other disquieting development is the increase in the number of alien natives found infected with human trypanosomiasis (sleeping sickness). Most of these cases have entered the Colony on foot and have passed through our northern fly belt *en route*. There is every possibility of new centres of sleeping sickness occuring in the Colony and the disease may break out either in an epidemic or endemic form. Prevention lies in a close medical examination of all immigrant labour before entering the Colony.

The following is a brief statement of the position to date in each area where operations are being carried out:—

1. **Darwin.**—The improvement mentioned in my last report has been maintained and further consolidated. A considerable increase in the number of native cattle maintained in the area has taken place during the year, and cattle are now being kept at kraals close to the escarpment. No cases of animal trypanosomiasis have been reported. The Masongerera footpath, one of the main routes taken by immigrant labour from the north, has been kept free of fly and the cleansing chamber on this path has been closed. For the time being it does not appear necessary to extend the area covered by the operations, and in consequence no addition has been made to the area cleared of fly. Any extension of the operations would necessitate the destruction of many rhinoceros. The operations in this area are carried out by unpaid native hunters.

2. **Sipolilo.**—A careful fly survey has been carried out in the portion of the area lying between the northern game fence and Chiwe Hill, as, according to native evidence, two flies were reported to have been seen near Chiwe Hill. No flies were located and all native and European-owned stock examined were found in good condition. No cases of trypanosomiasis have been reported and the estimated area of about 400 square miles, mentioned in last year's report as having been cleared of fly, has been kept clear.

3. **Lomagundi (Doma).**—Considerable movements of native-owned stock have taken place during the year, following the

outbreak of East Coast fever in the Umboe Valley. Some 1,400 head of cattle are now running inside the southern fenced zone, a number of them close to the middle fence and within the danger zone. Twelve additional paid hunters have been engaged to accelerate the eradication of the few remaining fly which persist in the vicinity of the Chipingabadza Vlei and also close to the northern fence. This slight infestation is probably maintained by constant infiltration along the Rakute River from the area north of the northern fence where operations have been in progress for only eighteen months.

If it is possible to maintain free of trypanosomiasis such a large number of cattle in the 300 odd square miles in the southern fenced zone, it will be a great achievement and will rank as the biggest effort at reclamation that has been carried out anywhere in Africa. The area already cleared of fly in this section is estimated to be about 600 square miles, but cattle have not as yet been permitted within the northern zone.

4. **Urungwe.**—A number of head of native-owned stock died of trypanosomiasis during the year in the eastern portion of the Urungwe Native Reserve. It is considered that this outbreak resulted from flies being carried from the centre and western side of the Reserve. There are very few resident natives on the western side of the Reserve, and it has been found necessary to employ twelve paid native hunters to clear up this area. It is not expected that much improvement will occur for several years owing to several factors which make effective reduction of the game difficult, *e.g.*, lack of water, the broken nature of the country, the presence of many rhinoceros and the annual movements of elephant from below the escarpment. These latter animals are not destroyed. There has been no deterioration in the general position.

5. **Lomagundi S.W.**—Only very occasional flies are now to be found in this area, and these are confined to the Umfuli River below the Chititimira (Beaconsfield) Falls. No cases of trypanosomiasis have been reported during the year nor for several years. No extension has taken place in the area covered by the operations, which have been carried on as before in order to maintain and consolidate the 300 square miles of previously infested country reclaimed up to date.

6. **Gatooma.**—The whole of the fenced zone is now considered to be free from fly, while in the area covered by the operations west of the western fence fly persists only in small numbers in a few areas which previously were very heavily infested. Fly appears to have been eradicated from the late dry season concentration ground around Chisambe Vlei, Nyampane Vlei and Java Java, and along the route traversed by the Rob's Drift Road. Similarly the previously infested area in the Gwelo district and around the Mafungabusi Peak have been maintained clear of fly. A number of cattle are now running on farms in the Golden Valley area where heavy losses occurred in the past. Considerable mining activity and felling of bush is taking place in the Golden Valley and Mafungabusi areas which will assist in consolidating the position.

In this area the country now cleared of fly is estimated to be about 900 square miles.

7. **Gwaai-Shangani Area.**—The rapid and progressive improvement which has taken place in this area has been most marked during the year. Previously very heavily infested, the whole of the Gwaai River Valley as far as its junction with the Shangani River is now cleared of permanent fly. Between the Gwaai and Shangani Rivers, where only three years ago very high fly densities were recorded at certain favoured localities in the Shangani Valley, no flies have been recorded during special surveys carried out twice during the year, nor have any flies been encountered during normal patrol work. The area south of the Shangani River is now considered to be free from permanent fly.

North of the Shangani River fly persists at several points, e.g., in the vicinity of the Gwaai-Shangani junction, at Luvimbe Vlei and up the Mzola and Kana Rivers, but the density has been very greatly reduced.

The open shooting area has been very much reduced in size and now only includes the Gwaai River Settlement Farms and a small area enclosed by the Bulawayo-Victoria Falls Road, the Inyantue River and the Gwaai River.

It should now be possible to re-stock the farms along the Gwaai River Settlement, although the Kalahari sand veld is

poorly grassed and incapable of carrying much stock. The amount of grazing present in the late dry season is both poor and scarce, except close to the Gwaai River. A few head of stock, principally milking animals, are now being introduced on to three of these farms. Farming operations during the past few years have been carried out by hand labour or by donkeys and mules. It will never be possible to employ oxen for ploughing in the wet vleis at present being cultivated for wheat, potatoes and vegetables, but the manure now becoming available will be a great asset.

Traffic Control.—In those areas where the cleansing stations are situated within the zone of operations, the return of flies caught at each station indicates very clearly the effectiveness of the operations. As previously indicated, five cleansing chambers have been closed down and one removed to a new site during the year. No cases of infringement of the regulations published under the "Tsetse Fly Act, 1929" have been reported.

It is interesting to note that at three chambers situated on the outside edge of the zone of controlled operations against game, the number of flies caught shows a considerable increase over former years. This probably indicates an increase in both fly and game in the undisturbed area.

Urungwe.—1. *Vuti Chamber.*—This station on the main Sinoia-Zambesi Road is situated on the northern edge of the operations and the number of flies caught shows an increase over previous years. This increase is accounted for by the increased traffic due to road construction parties and possibly to an increase in fly density north of the shooting area.

Five hundred and twenty-six (526) cars, six thousand three hundred and fifty-nine (6,359) pedestrians and three hundred and forty-five (345) cyclists, three hundred and ninety-two (392) parties, passed through the chamber, bringing a total of five hundred and nineteen flies (519)—three hundred and thirty-nine (339) male and one hundred and eighty (180) females. Of these 235 flies (156 male, 79 female) were taken off cars and 284 flies (183 male, 101 female) were taken off cyclists and pedestrians.

The number of flies caught at this chamber in 1932, 1933, 1934 and 1935 were—106, 94, 178 and 454 respectively.

2. *Manyangau Chamber.*—This station is erected on one of the main native footpaths leading from the Zambesi Valley to Miami. There has also been a considerable increase in the number of flies caught at this station which, like the Vuti Chamber, is on the northern edge of the operations.

Seven thousand seven hundred and fourteen (7,714) pedestrians and three hundred and fifty-three (353 cyclists, four hundred and fifty-five (455) parties), passed through the chamber, bringing a total of four hundred and one (401) flies (272 male, 129 female).

At this chamber two hundred and ninety-six (296) flies were cought in 1935.

Gatooma.—*Rob's Drift Road.*—The retrogression of fly in this area has proceeded to such an extent that it is now possible to travel by car from the eastern fence to Rob's Drift without picking up a single fly. It is questionable whether the maintenance of this chamber is justified on purely economic grounds at the present time. There is, however, a small amount of mining activity in the Rob's Drift area which may increase and some prospecting is taking place in the Copper Queen area which may lead to increased traffic. Although there is very little through motor traffic from the known fly area, so long as the chamber is in commission the few flies picked up are caught instead of being carried to the Golden Valley farming district. It is unfortunate that the only producing mine in the area west of the western fence has recently closed down. No flies were caught off pedestrians and only nine (9) off motor cars. All these flies originated in the vicinity of Rob's Drift well outside the shooting area.

One hundred and seventy-six (176) cars, bringing nine (9) flies (5 male, 4 female), and six hundred and ninety-five (695) pedestrians and five hundred and ninety-six (596) cyclists passed through the chamber during the year.

The number of flies caught at this station in 1932, 1933, 1934 and 1935 were 377, 498, 478 and 36 respectively.

Bulawayo-Victoria Falls Road.—Following the complete, or almost complete, disappearance of fly from that portion of the Gwaai River Valley traversed by the Bulawayo-Victoria Falls Road, four of the cleansing chambers in this area have been closed. This has necessitated the proclamation of a new defined fly area under the Tsetse Fly Act, 1929, and the publication of new regulations. These regulations have been designed to assist in the opening up of the new tin and tungsten deposits now being exploited in the vicinity of Hojokwe Mountain, east of the Gwaai River. Motor traffic is now permitted to cross the Gwaai and Shangani Rivers by two roads, Walker's Road and the new road leading to the new tin mines. Provision is made for freeing such traffic of tsetse flies on the return journey. The discovery of these new fields and the development of mining activity in this area may greatly assist in preventing fly spreading down the Gwaai River Valley towards Wankie and the Victoria Falls.

1. *Dett Valley Chamber.*—This chamber was closed in July, the last fly having been caught in March, 1935.

One hundred and fifteen cars (115), four hundred and eighty-nine (489) pedestrians and forty-five (45) cyclists (129 parties) were examined in the chamber during the year.

2. *Farm* 114 *Chamber.*—This chamber was closed in July, the last fly being caught off a motor car in April, 1935, and off pedestrians in March, 1936.

Six hundred and twenty (620) cars, two thousand four hundred and ten (2,410) pedestrians and seventeen (17) cyclists (240 parties) passed through the chamber bringing two (2) fly (1 male, 1 female) caught off pedestrians. One fly (1 female) caught off a pedestrian entering the area and one fly off a pedestrian leaving the area.

3. *Walker's Road Chamber.*—A cleansing chamber suitable for the cleansing of motor traffic has been erected at this station to deal with motor traffic crossing the Shangani River. The following traffic was examined during the year:—Six (6) cars bringing 1 fly (1 male), nine hundred and eighty-two (982) pedestrians, eight (8) cyclists (446 parties) bringing three (3) flies (1 male, 2 female). Total four (4) flies (2 male,

2 female). The number of flies caught at this station in 1932, 1933, 1934 and 1935 were 4,180, 989, 551 and 59 respectively.

4. *Sikumi Farm Chamber.*—This station was closed in July, the last fly having been caught off a pedestrian in July, 1935. During the year sixty-four (64) cars, three hundred and thirty-eight (338) pedestrians and five (5) cyclists (164 parties) passed through the chamber.

5. *Mabole Valley Chamber.*—(*a*) *Out of the Area.*—This chamber was closed in August, the last fly being caught off a motor car in May, 1935, and off a pedestrian in January, 1936. The following traffic was examined during the year:—Seven hundred and ninety-three (793) cars, four hundred and ten (410) pedestrians and twenty-three (23) cyclists (169 parties) bringing four (4) flies (3 male, 1 female) all off pedestrians.

(*b*) *Into the Area.*—Three hundred and seventy-two (372) pedestrians, twenty-three (23) cyclists (131 parties), bringing no flies, passed through the chamber.

The following table shows the number of flies caught at each station since the inception of traffic control in the Wankie area:—

Chamber.	1931.	1932.	1933.	1934.	1935.	1936.
(*a*) Dett Valley	230	336	183	59	5	Nil
(*b*) Farm 114 Chamber	128	299	152	104	22	2
(*c*) Walker's Road Chamber	—	4,180	989	551	59	4
(*d*) Sikumi Farm Chamber...	—	—	64	30	7	Nil
(*e*) Mabale Valley ...	—	—	154	196	18	4

(a) Since June, 1931.
(b) Since June, 1931.
(c) Since January, 1932. Closed to motor traffic August, 1932. Re-opened to motor traffic December, 1936.
(d) Since January, 1933.
(e) Since March, 1933.

Darwin.—In consequence of the greatly improved position in this area, particularly on the western side, the cleansing chamber on the Masongerera footpath was closed down on the

31st May and moved to the Kapanda footpath. The necessary alterations in the regulations under the "Tsetse Fly Act, 1929" were gazetted. The chamber at Nyamapara was destroyed by a gale in October, but is being replaced.

The following traffic was dealt with during the year:—

(a) *Nyamapara Chamber.*—Three thousand four hundred and twenty (3,420) pedestrians and fifty (50) cyclists, bringing four hundred and three (403) flies (274 male, 129 female).

The number of flies caught at this chamber in 1932, 1933, 1934 and 1935 were 112, 97, 85 and 161 respectively.

(b) *Masongerera Path* (closed May, 1936).—Four thousand five hundred and fifty-four (4,554) pedestrians, one hundred and forty-three (143) cyclists bringing no flies. No flies have been caught at this chamber for over two years.

The number of flies at this chamber in 1932, 1933, 1934 and 1935 were:—100, 12, 9 and nil respectively.

(c) *Kapanda Path* (opened June, 1936).—One thousand nine hundred and twenty-seven (1,927) pedestrians and seventy (70) cyclists, bringing fifteen (15) flies (9 male, 6 female).

Melsetter Border.—The beneficial effect of the thirty-five mile anti-tsetse clearing along the Melsetter Border has been most marked during the year. As far as can be ascertained only two new cases of animal trypanosomiasis occurred on the border farms protected by the clearing, and no cases occurred away from the border. The clearing has not been extended but protection work has been carried out and all re-growth slashed back. Owing to the abnormally wet winter, new green grass was both early and abundant, while the old season's grass failed to dry off, making a good burn very difficult. Much of the clearing only burnt patchily and many of the wooded kloofs, where grass growth was poor, failed to burn. It is considered that it should be possible to get a good burn two out of every three years and that this, assisted with annual slashing, will suffice to keep down re-growth to the desired level.

A fly survey carried out in Portuguese Territory, close to the Border, has brought to light the disquieting fact that

the tsetse, *Glossina morsitans,* is slowly spreading west through the low veld towards our border and there is a distinct threat that this fly may at some future date invade the Sabi Valley.

TSETSE FLY RESEARCH.

Laboratory research on *Glossina morsitans,* Westw., has continued on an intensive basis throughout the year. For this purpose 7,960 flies have been bred out at Salisbury from pupæ collected in the field.

For the purposes of comparison some work has also been carried out with the common Rhodesian house fly, *Musca domestica vicina,* Macq.

At the end of the year the field covered includes briefly the higher and lower fatal temperature limits over different priods of time, the effects of temperature and humidity on length of life under starvation, on longevity and reproduction, on development and on hunger. A great amount of time has been devoted to the physiology of the flies and results of considerable interest have been obtained. This latter work has mainly been concerned with the effect of environmental conditions on the water and fat content of the flies. To give some idea of the amount of work involved it may be stated that the fat content has been determined individually in no less than 2,445 flies during the year.

In addition certain investigations on the effect of environment on the behaviour of *morsitans* have yielded important results.

It is quite impossible in the present report to deal in any detail with the results obtained. The data largely still await collation and examination by statistical methods, a labour to which it has not as yet been possible to give much attention.

The possibility of practical application of the knowledge obtained is, of course, the most important point. Any pronouncement in this connection will have to await study of the eco- and micro-climates existing in the field.

A few points may, however, be mentioned. It is probable that at low altitudes in the late dry season the fly is sometimes in a precarious position due to the maximum shade temperature

during the day approaching very close to the lethal point. In fact, it is not at all improbable that the fly may be excluded from certain regions on this account alone, whilst in others the death rate may be very high during the peak temperature period of the year. A little modification of the environment in the way of destruction of necessary refuges, perhaps only of undergrowth, may make it impossible for the fly to survive this critical period.

Again, in certain parts of the fly area in Southern Rhodesia sharp frosts are frequent and, whilst these frosts call for measurement, they very possibly cause a serious mortality in certain otherwise very suitable country. It has been found that neither the adult nor the pupal *morsitans* can withstand more than a few degrees of frost for a few hours. Here again clearing of undergrowth might be a useful measure, as it would assist penetration of frost to the pupal sites.

As another point of interest, it is abundantly clear that during the latter part of the dry season when the temperature is highest and the atmospheric humidity is very low, the flies need more frequent and regular meals for survival than is the case at less exacting seasons. At that time of year, they are faced with the danger of death through evaporation of water from their bodies, which can only be replenished by ingestion of blood. An effective scheme resulting in separation of the fly and game at this period of the year might conceivably render continuous game destruction unecessary. Such an undertaking would certainly be difficult in practice, but the idea is worth bearing in mind for future reference.

The results obtained from the work on behaviour have an important bearing on trapping and may prove of value later in the field.

The collections of pupæ in the field during the past fifteen months have confirmed observations made by Mr. J. K. Chorley on the Umniati River from 1921-1923 to the effect that at certain seasons in this Colony the pupæ are subject to a high rate of parasitisation, especially by species of *Thyridanthrax* (Bombyliidœ) although *Mutilla* is also present.

It is difficult to conceive how this interesting fact can be put to practical use at present, but it reveals a weakness in the

annual cycle of the fly of which it may be possible to take some advantage when our knowledge increases.

There is a great deal of further investigation in prospect both on *morsitans* and *pallidipes*, the latter having not yet been studied.

As soon as the supply of pupæ dimnishes, as it is expected to do from January to April, it is proposed to draw up a comprehensive progress report on the work completed to date.

Trypanosomiasis Committee.—Four meetings of the Executive and one general meeting of the above Committee were attended during the year.

Myiasis in Sheep.—Several cases of myiasis in Merino sheep due to the blow-fly, *Chrysomyia chloropyga*, Wied., have been reported from the Melsetter district. The larvæ were found in the soiled wool around the anus of sheep suffering from "scour" and intestinal parasites, such as *Moniezia*.

Myiasis in Man.—The larvæ of the green bottle-fly, *Lucilia cuprina*, Wied., were reported from the body of an infant in the Bulawayo district. The larvæ of a "*skin-maggot fly*" referred to *Cordylobia* (*Stasisia*) *rodhaini*, Ged., were taken from the skin of a child in the Salisbury district during March and April.

Tick Survey.—The Spinose ear-tick (*Argus, or Ornithodorus mégnini*, Dugès.) has been reported from the Salisbury and Hartley districts. In the one case infestation occurred in a horse bred in the Colony but which had been stabled for some time, and in the other case infestation was noted in a pony imported from the Union of South Africa.

Publications.—

"Annual Report of the Division of Entomology for the year ending 31st December, 1935," by R. W. Jack. *Rhodesia Agricultural Journal*, XXXIII., 5, 1936, pp. 329-356.

"Biological Notes on some Diptera of Southern Rhodesia," by A. Cuthbertson, *Occasional Papers of the Rhodesian Museum*, Bulawayo, No. 5, p.p. 46-63.

"Ticks Infesting Domestic Animals in Southern Rhodesia," by R. W. Jack, *Rhodesia Agricultural Journal*, XXXIII., 12, 1936, pp. 907-929. (Illustrated.) Revision.

The Insect Collection.—The following numbers of insect species were identified by the Museums and other institutions named :—

The Imperial Institute of Entomology, London, 70.

The Britsh Museum (Nat. His.), 23.

The University Museum, Oxford, 14.

Zoologische Sammlung des Bayerischen Staates, Munich, Germany, 4.

The American Museum of Natural History, New York, U.S.A., 32.

State College of Massachusetts, Amherst, 12.

University of Harvard, Medical School, Boston, 3, and

Instituto de Biologia Vegetal, Rio de Janeira, Brazil, 5.

About 200 species of insects have been sent overseas during the year for identification.

A number of insects, including the types of species new to science, have been presented to the British Museum (Nat. Hist.), the American Museum of Natural History, the South African Institute for Medical Research, the National Museum of Southern Rhodesia and several other institutions.

ADMINISTRATIVE.

Tobacco Pest Suppression Act, 1933.—Under Part I. of the Act inspectors found the Tobacco Beetle, *Lasioderma serricorne*, Fab., in four farm premises and three central warehouses. The infected tobacco was burned. The Stored Tobacco Worm, *Ephestia elutella*, Hubn., was found on one farm premises and three central warehouses. In each case the infected tobacco was burned and a thorough cleaning of the premises, including spaces under floor, was effected. The total number of bales burned owing to infestation by insects was 117. A considerable additional amount of uninfested, more or less useless tobacco, was destroyed by fire, or used as fertiliser, etc., owing to the danger of its presence in tobacco premises. Two licences were temporarily suspended and five warehouses were placed under temporary quarantine during the year.

Under Part II. of the Act, small amounts of tobacco re-growth were found on many farms, and eight owners were cautioned for having re-growth on their lands after the fixed date. In each case proper clearing was effected, and five of the premises concerned were re-inspected by the B.S.A. Police.

The Tobacco Whitefly, *Bemisia rhodesiaensis*, Corb., was not abundant.

Number of Licences granted and Inspections made.

	1936.	1935.
Licences	595	586
Inspections	624	633

Importation of Plant Regulation Ordinance, 1904:

Number of Consignments of Plants, Fruits, etc., dealt with by the Plant Inspectors at the various Ports of Entry.

	1936.	1935.
Salisbury	2,343	2,719
Bulawayo	12,159	11,922
Umtali	837	765
Gwelo	1,062	882
Plumtree...	626	721
Beitbridge (to end Sept.)	40	7
	17,077	17,016

Number of Permits for the Introduction of Plants into the Colony.

	1936.	1935.
Special permits	214	143
Annual permits	60	60

Regulations in other Countries affecting Export of Plants from Southern Rhodesia.

Number of Certificates of Cleanliness issued in respect of Plants, etc., intended for export to other countries.

	1936.	1935.
Certificates	56	58

More certificates were issued in respect of potatoes destined for neighbouring countries than for any other class of plant or plant product.

Injurious Substances and Animals Ordinance, 1909.

Number of Permits issued for the Importation of Beeswax and Foundation Comb from Overseas.

	1936.	1935.
Foundation comb	—	1
Beeswax	3	1

It should be noted that the above permits are in respect of importation from overseas only. Beeswax and foundation comb accepted into the Union of South Africa may be imported from that country without further permit.

Nurseries Ordinance, 1909.

Number of Nurseries Registered and Inspected.

	1936.	1935.
Registered nurseries...	16	18
Inspections...	12	19

GENERAL.

Farms Visited.—Eighty-five farms were visited and in many cases advice given on insect pest control, besides the six hundred and twenty-four inspections made under the Tobacco Pest Suppression Act, 1933.

Lectures and Demonstrations.—A lecture on "Insects" was delivered to scholars of a Salisbury school, and a demonstration in poison baiting against locust hoppers was given to farmers by members of my staff. One lecture on Ticks was given to the B.S.A. Police.

Acknowledgments.—*Assistance from other Departments and Divisions.*—I have pleasure in acknowledging the usual cordial co-operation of the Native Department and the B.S.A. Police in connection with tsetse fly operations during the past year, and also of the Native and Law Departments in conneciton with the locust invasion.

Assistance in reference to Tsetse Fly Research has been received from the Division of Chemistry and the Meteorologists, of which grateful acknowledgment is made. The Public Works Department has also been most obliging and helpful in connection with the same undertaking.

Southern Rhodesia Weather Bureau.

MAY, 1937.

Pressure.—Mean barometric pressure was about normal over the country.

Temperature.—Mean temperatures were about normal during the month.

Weather Features.—On the 1st and 2nd an anticyclone lay over the interior of South Africa, but a rise of pressure on the 3rd transferred the centre to Durban. Weather was fair and cool, but following the rise of pressure the Eastern Border area became overcast, and some drizzle was reported. Clearing took place on the 5th.

The period from the 4th to the 12th was characterised by the passage of several lows across the south coast, the pressure over the interior falling steadily during the period. Weather was fine and both day and night temperatures were above normal.

From the 13th to the 18th highs were forming over the west coast of the Union and moving in a north-easterly direction, pressure meanwhile remaining relatively low over the south-east coast. The cold air brought in by the highs affected the west of Southern Rhodesia on the 15th. Conditions on that day were unstable, and a few showers were reported, including a fall of hail at Bulawayo. A very heavy thunderstorm occurred on the morning of the 16th at "Home Farm," Selukwe, where 3.08 inches was registered in 2 hours 50

minutes. "Safago" recorded a small fall, but reported heavy rain all round, and Selukwe Gaol received 1.67 inches. Weather continued cloudy and cool.

A low passed across the south coast on the 19th and 20th, and another affected the south-east coast on the 22nd. Weather became fine but remained cool.

A rise of pressure occurred on the 23rd, and by the 24th an intense high was centred over Transvaal. A short spell of cold overcast weather ensued with drizzle and showers in parts. The high remained central over the interior until the end of the month, but weakened considerably on the last two days. Nights were cold, but day temperatures moderate after the 25th.

MAY 1937.

Station.	Pressure Millibars, 8.30 a.m. Mean.	Normal.	Temperature in Stevenson Screen °F. Absolute. Max.	Min.	Mean. Max.	Min.	½ Max. Min.	Normal.	Dry Bulb.	Wet Bulb.	Rel. Hum. %	Dew Point F.	Cloud Amt. 0-10	Precipitation. Ins.	Normal	No. of Days	Altitude (Feet)
Angus Ranch... ...	...	...	88	40	79.1	51.3	65.2	65.4	63.0	57.4	72	54	...	0.00	0.20	...	...
Beitbridge...	968.7	...	95	42	84.6	53.0	68.8	...	65.7	57.4	60	52	1.7	0.00	0.36	...	1,500
Bindura...	895.4	...	82	39	76.8	49.5	63.1	...	62.3	55.9	67	52	2.1	0.00	0.50	...	3,700
Bulawayo	873.0	873.1	82	42	75.1	47.4	61.3	61.1	60.9	52.1	55	44	1.5	0.48	0.35	1	4,393
Chipinga	895.9	...	84	46	73.8	52.8	63.3	...	64.6	57.4	66	53	1.5	0.33	1.00	2	3,685
Enkeldoorn...	860.9	...	80	38	73.1	48.2	60.6	60.9	60.6	53.1	62	47	1.1	0.00	0.32	...	4,788
Fort Victoria	899.4	899.3	85	33	76.1	45.7	60.9	59.9	60.5	54.3	67	50	0.8	0.00	0.33	...	3,571
Gwaai Siding	908.1	...	97	33	83.7	41.5	62.6	...	55.5	49.4	65	44	1.0	0.00	0.12	...	3,278
Gwanda...	909.9	...	89	35	78.0	46.0	62.0	...	61.9	54.2	61	48	1.1	0.00	0.31	...	3,233
Gwelo	865.6	...	81	35	73.0	46.5	59.7	60.8	58.2	52.1	67	47	1.5	0.76	0.30	1	4,629
Hartley...	889.1	...	84	36	77.8	45.9	61.9	63.4	61.8	54.3	61	48	0.9	0.00	0.26	...	3,879
Inyanga...	839.9	...	77	30	70.8	44.0	57.4	...	60.9	51.3	51	43	1.4	0.11	0.50	2	5,503
Marandellas	840.7	...	75	40	69.9	48.6	59.2	...	58.1	51.6	65	46	1.8	0.02	0.62	1	5,453
Miami	882.1	...	81	42	75.5	50.6	63.1	...	63.3	56.5	66	53	1.9	0.00	0.04	...	4,090
Mount Darwin ...	911.5	...	86	36	79.6	48.2	63.9	..	64.8	58.2	67	54	2.4	0.05	0.45	1	3,179
Mount Nuza	804.4	...	68	38	59.5	46.5	53.0	...	52.4	48.0	75	44	4.1	1.68	1.55	6	6,668
Mtoko	880.8	...	81	45	74.6	53.1	63.8	...	63.3	56.8	67	53	0.6	0.21	0.34	2	4,141
New Year's Gift...	...	...	89	42	80.0	50.1	65.0	...	61.1	57.3	79	54	...	0.17	0.43	2	2,690
Nuanetsi	966.5	...	94	38	83.1	49.8	66.5	...	64.2	57.4	67	53	2.0	0.00	0.27	...	1,581
Plumtree	868.0	...	82	45	74.9	51.7	63.3	...	63.9	51.9	43	41	0.1	0.00	0.69	...	4,549
Que Que	885.4	...	85	39	78.6	47.7	63.2	...	61.8	53.6	58	47	1.0	0.02	0.24	1	3,999
Rusape	865.5	...	79	34	72.4	45.9	59.1	...	56.4	52.7	79	50	1.0	0.38	0.35	3	4,648
Salisbury	859.5	859.5	79	37	74.3	47.7	61.0	61.0	61.2	53.0	58	46	1.4	0.03	0.47	1	4,831
Shabani...	914.2	...	87	41	77.4	48.9	63.2	...	63.5	54.8	58	48	2.0	0.01	0.45	1	3,131
Sinoia	892.1	...	85	34	79.1	44.7	61.9	...	60.9	54.4	65	49	1.3	0.02	0.35	1	3,795
Sipolilo	888.7	...	81	39	75.4	50.3	62.9	...	64.6	56.9	62	52	1.6	0.09	0.34	2	3,876
Stapleford	845.1	...	73	27	65.5	41.3	53.4	...	55.3	52.2	82	50	3.5	1.37	1.40	7	5,304
Umtali...	896.7	896.5	87	41	76.4	51.2	63.8	62.6	62.6	57.6	74	54	2.8	0.34	0.51	4	3,672
Victoria Falls... ...	916.0	...	91	36	84.5	46.3	65.4	...	62.8	54.8	60	49	0.7	0.00	0.42	...	3,009
Wankie	931.1	...	93	45	87.2	54.8	71.0	...	64.3	56.0	59	50	0.5	0.02	0.32	1	2,567

Southern Rhodesia Veterinary Report.

APRIL, 1937.

DISEASES.

No fresh outbreaks of scheduled diseases.

TUBERCULIN TEST.

One bull was tested upon importation with negative results.

MALLEIN TEST.

Twenty-seven horses and one mule were tested. No reactions.

IMPORTATIONS.

From the Union of South Africa.—Horses 18, mule 1, bull 1.

EXPORTATIONS.

To the Union of South Africa.—Oxen 121, cows 3.

EXPORTATIONS—MISCELLANEOUS.

To the United Kingdom in Cold Storage.—Chilled beef quarters, 9,499; frozen boned beef quarters, 5,901; frozen beef quarters, 4,577; kidneys, 2,952 lbs.; tongues, 17,701 lbs.; livers, 34,402 lbs.; hearts, 12,413 lbs.; tails, 5,066 lbs.; skirts, 4,289 lbs.; shanks, 12,812 lbs.; glands, 86 lbs.

Meat Products.—From Liebig's Factory: Corned beef, 21,600 lbs.; meat extract, 21,600 lbs.; rolled beef, 180 lbs.; beef powder, 102,101 lbs.; meat meal, 30,000 lbs.; bone meal, 60,000 lbs.

S. A. MYHILL,
Acting Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-37.

Monthly Report No. 54. May, 1937.

The winged swarms of the Red Locust (*Nomadacris septemfasciata*, Serv.) reported as having appeared in the north-eastern districts of the Colony during last month have remained throughout May confined to practically the same area.

The districts mentioned during May are Lomagundi, Mazoe, Inyanga, Makoni and Salisbury township itself towards the end of the month.

Considerable local damage has been reported in one part of the Inyanga district, due to several swarms which had lingered in the vicinity for a week or more.

Whilst no locust hoppers are known to have appeared in swarm formation on the higher veld during the past season, several specimens of last stage solitary hoppers of the Red Locust were taken in the Mazoe district during May, indicating breeding by scattered adults.

RUPERT W. JACK,
Chief Entomologist.

NOTICE

The Agricultural Journal of S. Rhodesia

is issued by the Department of Agriculture, and can be obtained upon application to the Editor. The Annual Subscription, which must be paid in advance, is 5/-, and payment may be made by any means other than by stamps.

A 10/- note will cover the subscription for two years.

Persons residing outside Southern and Northern Rhodesia may become subscribers by paying 2/- in addition to the subscription, to cover postage.

If payment is made by a cheque drawn on a bank outside Rhodesia, commission must be added.

All cheques and postal notes must be made payable to the Secretary for Agriculture and Lands.

Date.........................19......

To the Secretary,
Department of Agriculture and Lands,
Salisbury.

Please enrol me as a subscriber to the "Rhodesia Agricultural Journal" for one year from.......................................

19......, for which I enclose...

Name...

Full Postal Address..................................

..

..

Please write distinctly

Unveiling Berry Memorial Glendale Farmers' Hall by H. D. Rawson.

THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.
(Assisted by the Staff of the Agricultural Department).

PUBLISHED MONTHLY.

Subscription: 5/- per annum; payable to the Accountant, Department of Agriculture, Salisbury.

Vol. XXXIV. AUGUST, 1937. No. 8.

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Export of Frozen Porkers.—If sufficient support is forthcoming, it is intended to export a consignment of frozen porkers of one hundred to one hundred and fifty pigs to the United Kingdom early in December next.

A price of $4\frac{1}{4}$d. per pound live weight, Bulawayo, will be paid for all porkers delivered at the Rhodesian Export and Cold Storage Company's works, Bulawayo, and passed for export. Any rejects will be sold on the local market in Bulawayo on behalf of the sender, and any railage paid by the Government thereon will be deducted from the proceeds of sale.

The Department of Agriculture will pay railage from Salisbury and intermediate stations to Bulawayo on lots of ten suitable pigs and over. Railage on smaller lots must be paid by senders.

Pigs intended for this consignment should weigh between ninety to one hundred pounds live weight at Bulawayo, and should be under five months of age.

Pigs which have been fed on oily or fatty foods will be rejected. Preference will be given to the Large White and Large Black cross.

Any pig breeder interested in this shipment should communicate as soon as possible with the Secretary, Department of Agriculture and Lands, P.O. Box 387, Salisbury. Applications will be dealt with in rotation until the consignment is completed.

An Interesting Event at Glendale.—An interesting event took place at the Glendale Farmers' Hall on June 4th, when the Berry Memorial plaque was unveiled by Mr. H. D. Rawson. The inscription on the plaque reads as follows:—

> "In memory of Hermanus Johannes (Boyce) Berry, member of the Mazoe Patrol, who came to Rhodesia in 1894 and donated the plot on which this hall is built in perpetuity to the farmers of the district. Born 1871. Died 1934."

Reading from left to right, the persons standing along the wall are: Messrs. Gilmour Southey, T. Huxham, V. Fynn, J. Waddel, W. S. Honey, H. D. Rawson, W. E. Thurlow, J. Dunlop, Chris. Southey, R. P. Newett, Jan Depreez, H. E. Wiggill and W. Sole. Messrs. W. S. Honey and H. D. Rawson were memebrs of the Mazoe Patrol.

The photograph was taken by Mr. E. Seymour White, of Concession.

Camp Sites: Rhodes Inyanga Estate.—Two rest camps have been built in the neighbourhood of the Pungwe Falls for short-time occupation by the public. The camps are situated at a distance of about thirteen miles from the Rhodes Inyanga Hotel and homestead and are adjacent to the Inyanga-Umtali road.

Each camp consists of a detached kitchen and store of brick under iron and a block of three rooms of brick under thatch. The kitchen is provided with an open grate and a table. The living rooms are furnished with four beds and mattresses, one dining table, two bedside tables, three stools, one washstand and basin, and one hurricane lamp.

Camps are in charge of a native, who will provide the necessary wood and water, but who is not expected to perform any other services for campers.

The rent payable will be 5/- per twenty-four hours or part thereof, or 30/- per week. Camps may not normally be hired for more than fourteen consecutive days by any one party.

Application for the hire of a camp should be made at least fourteen days in advance to the Manager, Rhodes Inyanga Estate, P.B. Rusape, and for a definite period. Payment for the whole of the proposed period of occupation must be made in advance, but should not be effected until advice has been received that a camp will be available for the period required. Tickets will be issued, which should be handed on demand to the native in charge of the camp.

Campers will require to provide all camping equipment which they may consider necessary, other than that mentioned in paragraph two above.

A lorry service from Inyanga to Umtali passes within a mile of the camps, leaving Inyanga on Tuesdays and returning on Wednesdays.

Salisbury Show.—The 36th Annual Show of the Rhodesian Agricultural and Horticultural Society will be held at the Show Grounds, Salisbury, on Wednesday and Thursday, August 18th and 19th, 1937.

The programmes for the two days are up to the usual standard and will undoubtedly prove a great attraction.

Vice-Admiral Sir Francis Loftus Tottenham, C.B., C.B.E., Commander-in-Chief, Africa Station, has kindly consented to open the Show, and Lady Tottenham will accompany him.

The siding into the show grounds has recently been constructed by the Rhodesia Railways. The capital outlay of the siding has been shared between the Salisbury Municipality and the Rhodesian Agricultural and Horticultural Society. By this means cattle will have access to the Show from clean areas this year, and for future years. Approximately three hundred head of cattle have already been entered for this year's Show.

A permanent building of brick and iron has been constructed for the housing of the dog section. Stabling and accommodation for twenty-five horses is under construction and will be completed in time to accommodate the horse entries for this year's Show.

Tobacco Growers: Please Note.—The Council of the Rhodesia Tobacco Association is very concerned about what they believe to be a serious increase of the eel-worm infestation of tobacco lands. They have approached this Department with a request that a questionnaire be submitted to every tobacco grower, in order to ascertain as far as possible the exact position regarding this serious problem.

Although tobacco growers are chiefly concerned, the observations of any farmers, whether tobacco growers or not, will be welcomed.

The points upon which information is especially required are indicated below, but it should be noted that the questions refer to tobacco, with the exception of No. 7:—

1. Have you discovered any evidence of eel-worm in your lands?
2. If so, what percentage of your cultivated lands do you estimate to be infested?
3. Have you any evidence that the infestation has increased during recent years?
4. Were all your tobacco lands stumped and cleared by you, or did you use any land previously cleared and possibly used as a native garden?
5. Have any of your infested tobacco lands previously grown other crops? If so, what?

6. Have you ever discovered eel-worm in your seed-beds? If so, from what source was the water derived?
7. Have you a definite idea or proof of the source of infestation, and have you any evidence of eel-worm in virgin land?
8. Have you any procedure which overcomes or appears to reduce this infestation? If so, what?

Please address replies to the Secretary, Department of Agriculture and Lands, Box 387, Salisbury.

Treating Tobacco Seed.—Recognising the importance of using properly cleaned and chemically treated tobacco seed, this Department has for the last few years undertaken this service on behalf of the tobacco growers. The fee charged is 6d. per ounce of cleaned seed. The treatment is carried out by the Chemistry Branch, and as provision has to be made to supply this service without interference with the other duties of the technical staff unduly, farmers are requested to send in their seed for treatment as early as possible.

Frenching of Tobacco.—In the report recently published by Mr. E. L. Spencer in the *American Journal of Botany*, an interesting series of experiments is described testing the effect of various minerals on the growth of the tobacco plant. The study was undertaken to ascertain whether frenching of tobacco might be caused by the presence of some toxic substance in the soil.

Turkish tobacco seedlings were germinated and cultured in quartz sand, supplied with a nutrient solution, and submitted to the action of thirty-three selected elements. Mercury, selenium, iodine, cadmium, cobalt, nickel and thallium were the only elements found toxic to the seedlings in concentrations as low as five parts per million, and thallium was the only element tested which at this concentration or less produced chlorosis, strap-shaped leaves and other symptoms of frenching.

The first visible symptom of thallium toxicity was the yellowish-green colour of the young leaves, which was followed by interveinal chlorosis near the base of the midrib

of the tip leaf. Subsequently, the chlorosis extended along the midrib, and then diffused laterally towards the outer margins, until it covered the entire leaf, the dark green veins being easily differentiated. Later, the tip leaves became long and ribbon-shaped. Extreme thallium toxicity led to a restriction of terminal growth, and stimulation of the axillary buds, in which growth in turn became restricted; rosettes of small, chlorotic, strap-shaped leaves developed. These symptoms were very similar to those of natural frenching, except that the chlorosis due to frenching develops first at the base of the tip leaf and then extends along the leaf margins instead of the midrib.

The minimum concentration of thallium that produced chlorosis was 0.067 parts per million in nutrient water cultures, 0.10 p.p.m. in quartz sand cultures, 0.38 p.p.m. in orchard soil (a light, sandy, non-toxic loam), watered weekly with thallous nitrate, and 0.25 p.p.m. in field soil (a heavy clay loam that caused severe frenching), treated similarly.

For the final proof of the identity of frenching with thallium poisoning, the presence of thallium in soils which produce frenching requires to be demonstrated, but it is doubtful whether chemical methods are available at present sensitive enough to detect such small traces of the element as employed in the experiments reported.

Deficiency Diseases of Crop Plants.—The growing interest in the deficiency diseases of crops is largely due to the increase of our knowledge as to their cause and remedies, but it is also probable that they are actually more prevalent than they used to be. Organic fertilisers, such as farmyard manure, contain a considerable variety of elements, and their continued use helps to maintain the requisite supply of the nutrients that are needed only in small quantities. This source of supply has become less with the decreasing use of organic manure and the increase in artificial fertilisers, particularly with the continued improvement in the purity of the latter. It is quite possible that, owing to this, on some soils the available amount of such subsidiary plant foods as boron and manganese is falling below the limits required by certain crops, with the result that deficiency diseases appear or

become more widespread than formerly. It is of great importance that this fact should be realised and careful watch kept for signs of trouble, as unnecessary loss may otherwise be incurred. In those instances where the cause of deficiency is already known the remedy is cheap, readily available and easy of application. In others, where deficiency is suspected, but not traced to its source, it may be anticipated that further information will become available if the active co-operation between practical agriculturists and scientific workers is maintained and fostered.

At this stage a word of warning may not be out of place. The majority, if not all, plant nutrients become poisonous or at least somewhat harmful if they are supplied in too great quantities. Large amounts of nitrogen, potash or phosphate are necessary before any damage occurs, but quite small amounts of borax, copper, zinc, thallium, etc., are actively poisonous and will severely damage or even kill the plants. For instance, considerable losses of potatoes and other crops occurred in America during the war owing to the use of fertilisers containing borax ranging up to 2.3 per cent., especially when it was applied in the furrows, and the harmful effect of excess manganese has already been demonstrated. As the symptoms of deficiency and poisoning may resemble one another, care is needed to avoid confusion, and the possible supply of toxic amounts of certain elements in artificial fertilisers needs to be guarded against. In one instance, for example, it was found that the failure of basic slag to produce results proportional to expectations was apparently due to the presence of small quantities of vanadium, whose poisonous properties acted in opposition to the beneficial effect of the phosphorus in the slag.

For the reasons given, it is advisable that applications of such substances as borax and manganese sulphate should be made only where they are known to be needed, and the general consensus of opinion is against their inclusion in compound fertilisers for general use. Some crops need so much less of these subsidiary nutrients than others that there is danger of accumulation of poisonous quantities in the soil if dressings are applied without discrimination.

Some Tobacco Pests that can be serious.

By M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.

Broadcast from Salisbury on 30th July, and published by permission of the Acting Postmaster General.

When one glances through a text-book on the theories and practice of the control of insects, one will usually find at least a chapter outlining fundamental methods of control. This will include *natural* means, such as hand-picking, cultural methods, parasites, and many others. It will include *artificial means*, such as the use of poisons, contact substances, and fumigants. But it will further include *legislative* means—that is, the enforcement by law of one or more methods of the types I have just suggested.

The pest known as Tobacco Whitefly,* the vector of leaf-curl disease of tobacco, is a good example of a pest, the control of which is enforced by legislation for the well-being of the industry as a whole. This insect can be reasonably well controlled by inexpensive cultural methods. If it is not so controlled, it will increase and spread throughout entire lands and on to neighbouring properties, carrying leaf-curl infection to large portions of the crop. The danger of this is so serious that it is obviously necessary that growers control the insect on their own premises. Because control is necessary, practicable, inexpensive, and for the good of the State as a whole, it has been made compulsory by law.

The legislation referred to is known as the "Tobacco Pest Suppression Act, 1933." The provisions of the Act aim at the enforcement of prescribed control measures directed

Bemisia rhodesiaensis, Corb.

against certain pests of tobacco that may severely affect the growing crop, and against others that may attack the cured product, and thus seriously affect the price (as has happened in the past) of the whole Rhodesian crop for several years, whether the infestation continues or not. The fear of such an infestation is sufficient in itself to depress the market.

Let us consider in more detail the insects declared as pests under the Act.

The tobacco whitefly, already mentioned, is a pest of growing tobacco. It sucks the sap of the plant and, while thus feeding, the adult is capable of infecting a healthy plant with the virus of leaf-curl disease which it has picked up from an infected plant. The adult is a tiny insect, somewhat like a jassid, with four powdery-white wings. Usually it is found on the under surface of the leaves, but frequently it may be seen on the upper surface, and the young, after hatching, crawl about the under surface for short distances before they settle down to feed. When they settle, their legs degenerate, and the insects remain attached to the same spot on the under surface of the leaf until they reach the winged or adult stage. Where there is a group of plants suffering from leaf-curl, the young stages of whitefly can often be found as small, yellowish, scale-like insects on the under surfaces of the lower leaves. Such lower leaves less frequently show the symptoms of leaf-curl, although adults that have come to maturity on them can carry the disease elsewhere. The adults are not known to fly far in still air, though it is possible they may do so. However, when in flight, they can be carried by a slight breeze for considerable distances.

Normally, the tobacco whitefly is easily kept under control. In discussing war on insects two terms are commonly used—namely, "control" and "eradication." Now, control does not necessarily mean eradication, although eradication, which is an ideal, is an excellent and complete means of control. The completeness suggested by the word "eradication" should be borne in mind. With the tobacco whitefly, the aim should be to control the insect by the eradication,

at the end of the growing season, of all tobacco plants anywhere on the farm, and to persuade one's neighbours to do likewise. Eradication is an apt word for our present purpose, as it means, literally, "out-rooting." This is what must be done to unwanted tobacco plants—they should be pulled out by the roots, in preference to being cut off at the stem below ground as is so often done.

Pulling can usually be accomplished without much difficulty if it is done early in the season before the soil has caked hard. When pulling is completed, one or more natives can be assigned to the duty of patrolling the lands and digging out volunteer plants and re-growth that may have sprung up from broken roots. All the plants removed from the land should be burned or otherwise effectively destroyed. The farm programme should be arranged so that the lands are ploughed immediately after the plants have been pulled out and carted off the lands.

Seed-beds should be similarly cleaned up as soon as all the plants required have been removed, the remaining plants and weeds being destroyed. A few plants are likely to be found growing near the barns or sheds. These also should be destroyed. By law, growing tobacco must be destroyed by 1st August, or in the case of Turkish type tobacco, by 1st September. Every police officer is an inspector under the Act, and is authorised to inspect tobacco lands and, if necessary, enforce the provisions of the law.

The foregoing measures, if carried out properly and early, should eradicate tobacco plants from the farm in the "off" season, and reduce to a minimum the occurrence of whitefly on the property during the next growing season, provided that there is no infestation from neighbouring farms. The danger from neighbours is the chief reason for legislation for the control of this pest; in other words, each grower is in some measure made responsible for the harm he may do to his neighbours, either knowingly or unknowingly.

During the growing season, to prevent the completion of development of whitefly on primed leaves, native overseers

should be instructed that all discarded leaves should be destroyed immediately. The grower should himself ensure that this is carried out.

Leaf-curl disease also is a pest within the meaning of the Act, but we shall not discuss it in detail, for it is reduced to a minimum where whitefly is kept under control.

Every efficient grower who, realising the extent to which the hygienic methods recommended keep down not only white-fly, and in consequence leaf-curl, but also many other diseases and insect pests of tobacco, will map out his farm programme in such a way as to ensure the early and thorough prosecution of the methods advised by the Department.

So much for declared pests of *growing* tobacco.

We shall now consider two insects that attack *cured* tobacco, both of which are declared pests under the Act. One is the Stored Tobacco Worm,* the caterpillar of a moth almost indistinguishable from some of the moths found in one's pantry or storeroom. The other is a small, brown, cylindrical beetle, with the head directed downwards, that may sometimes be found in the house consuming such products as dried soups, orris root and similar products. It is known as the Stored Tobacco Beetle,† Cigarette Beetle, and incorrectly, Tobacco Weevil. As the life histories and prevention or control of the two pests are in many respects similar, we shall consider them together.

These insects are largely dormant during the winter, but in September the autumn and winter accumulations of the immature insects change into the adult stage. The adult females deposit their eggs during September and October, and the young hatch in a week or so and commence feeding on cured tobacco or certain other foods. There are two or more generations during the year, the rate of multiplication being enormous. In August each year nearly all the individuals of these two species of insect are preparing to

***Ephestia elutella*, Hubn.

†*Lasioderma serricorne*, F.

become adults and subsequently to mate for egg-laying purposes. At no other time of the year are starvation methods of control more effective than during August.

Now, in most tobacco premises, it is quite possible, before the end of August, to dispose of the whole crop and clean up and destroy all the remaining tobacco that may be present, including waste and dust. Cleaning up includes the destruction of every scrap of tobacco that can be found on or near the premises. We shall not go into details concerning the places where scraps of tobacco can accumulate; they have been described in more than one bulletin issued by the Department, and any grower will find such places if he conscientiously looks for them. It might be mentioned, however, that wherever scraps of tobacco become lodged, there also can the young stages of the insects exist and usually find sufficient nourishment to complete their life cycle.

One female moth of the stored tobacco worm can produce about 200 eggs. Most of the eggs are fertile. In several fertility tests carried out in Salisbury, 1,825 eggs, deposited under artificial conditions, were kept under observation. The percentage of fertility varied from 90.2 to 96.5, with an average of 95.58. No parasites of the egg have been found in Rhodesia. Where eggs are laid, and there is no food within reach, the newly hatched young must die in a few days. But food does not mean tobacco only. The insect can feed on other foodstuffs, and it is therefore most inadvisable to keep alternative sources of food in or near the tobacco premises. Such substances have been enumerated in official publications.

Finally, a word of warning must be given regarding a danger which has recently developed. It is the general practice now to return the paper and hessian wrappings of tobacco bales sold on the auction floors to the farms whence they came. By the end of the season this material may collectively have passed through two auction floors and half a dozen central warehouses before being returned, accompanied by scraps of tobacco, to the owners. Thus it has been

exposed to the possibility of infestation in centres where pests are most likely to occur—namely, warehouses where tobacco is stored for longer periods than on a farm, and where tobacco is gathered from all parts of the country.

The simplest treatment of these wrappings is, immediately on their arrival, to distribute them over the racks in a dry barn as though they were being aired, and to heat the barn to a temperature of not less than 125°F. After twenty-four hours at this temperature, the fires may be allowed to die out. The barn may be opened when it has cooled. The adoption of this measure, or the alternative of fumigating with carbon bisulphide in drums, tanks or other suitable receptacles, is strongly recommended as a strict routine on all tobacco farms.

Remember the old proverb: "Cleanliness is next to godliness." In this instance, cleanliness is also a good business proposition. Thus we can repudiate the popular saying that business and godliness cannot go hand in hand.

Weeds of Southern Rhodesia.

PART II.

By Chas. K. Brain, D.Sc., Director of Agriculture.

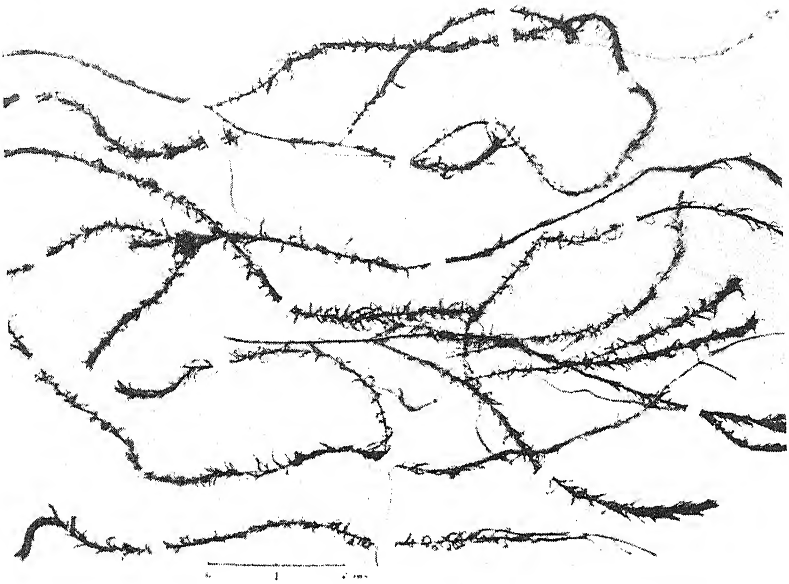
WATER WEEDS.

A short time ago an enquiry was received from the Town Engineer of Gwelo regarding a plant which was increasing at an alarming rate in the municipal dam. It was desired to know whether the plant was an introduced one; whether it would impart an objectionable taste to the water; and whether it would harbour bilharzia. The plant submitted was an indigenous one, *Potamogeton javanicus* Hassk., but there are a number of other water plants in this country which may become weeds in streams, dams and permanent furrows.

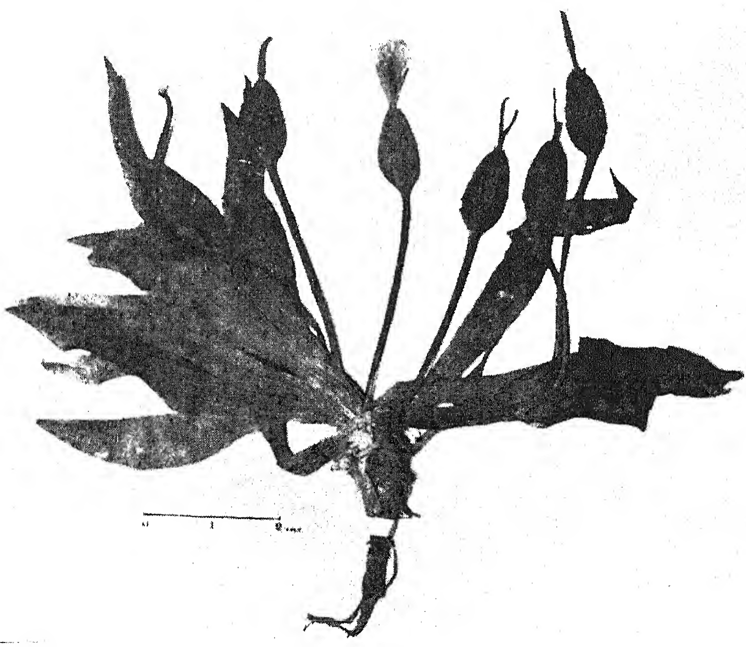
None of these is known to cause any objectionable condition in the water so long as it is living, but some of them form such dense mats that the dead material may cause an objectionable colour and taste in stagnant water such as is found in dams. One at least increases to such an extent that the stream or dam may become entirely blocked. The main objection to all of them, however, is that they encourage snails, which feed upon them, and all water heavily infested with snails in this country contains the organisms causing bilharzia.

All of them, with the exception of the introduced water hyacinth, are indigenous plants and have their roots in the mud at the bottom of the water. The water hyacinth floats and has roots which can function without reaching the mud, but which act as ordinary roots when growing in very shallow water. Unfortunately, no means of control are known except mechanical ones—*i.e.*, actually pulling the weeds out and destroying them. No substance is known which could be used to destroy the plants without killing all animal and plant life in the water and rendering it dangerous to animals drinking it.

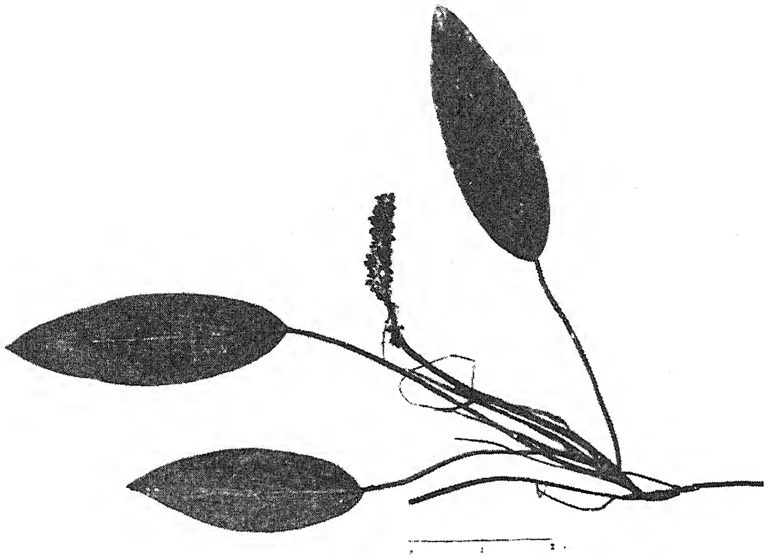
The Water Hyacinth in flower. (Copied from Miss K. Lansdell's illustration in Union of S.A. Department bulletin).



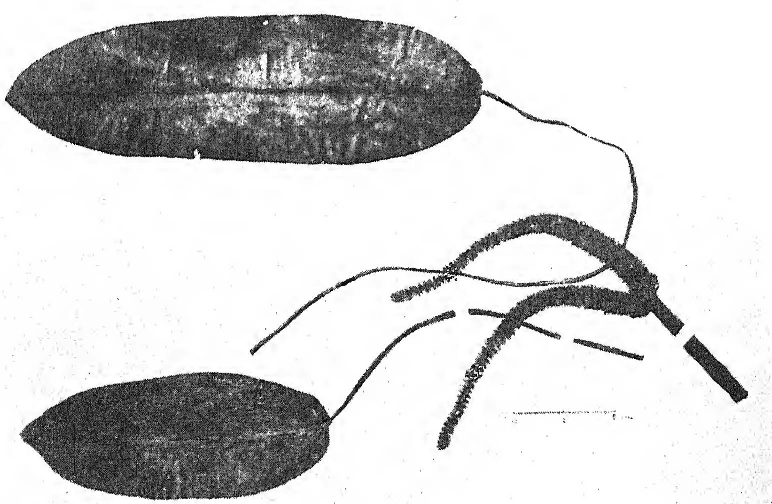
Lagarosiphon muscoides, Harv. Cleveland Dam, Salisbury.



Ottelia vesiculata, Ridl. Stream near Salisbury.



Potamogeton fluitans, Roth. Cleveland Dam. Salisbury.



Aponogeton holubii, Oliv. Hunyani River.

The common water lily, *Nymphaea stellata* Willd., is too well known to need description. It is found practically throughout Africa and is common in India. The most remarkable thing about it is its range of variation, depending upon the conditions under which it grows. The flowers vary in size from an inch or so up to nine or ten inches, and in colour from white, blue, purplish or rose.

The commonest water plants in this country are the different species of *Aponogeton* and *Potamogeton*. These two genera are closely related, but the Rhodesian specimens may be easily separated by the fact that in the former the flower head consists of a bifid spike, and in *Potamogeton* the spike is simple. Botanically they are separated by the fact that the small flowers clustered on the spikes of *Aponogeton* only have one to three sepals, which are usually white or yellow. In *Potamogeton* the small flowers have four sepals which are green.

The three common species of *Aponogeton* are easily separated. The small species, with narrow leaves almost like leaf-stalks, is *Aponogeton spathaceus* E. Meyer., which has white or pale mauve flowers. It is common in the mud on the banks of streams or in swamps. It is never found in deep water. *A. holubii* Oliv. is the largest species, with oval leaves up to six inches long, and the branches of the yellow bifid spike up to three and a half inches. *A. Eylesii* Rendle has smaller leaves and spikes. Both these latter live in deep water with the leaf blades lying flat on the surface and the bifid spikes reaching above the surface where insects can visit them.

There are two common species of *Potamogeton*, viz.: *P. fluitans* Roth., which has leaves two to three inches long which float on the surface; *P. javanicus* Hassk. has very slender stems and many short leaves usually less than half an inch long, which are submerged.

Lagarosiphon muscoides Harv. is a moss-like water weed with slender stems up to two feet long and short slender leaves. It is common in the shallow water at the sides of streams, where it makes dense masses which are the favourite haunts of water snails.

Ottelia vesiculata Ridl. is a common weed in shallow water at the edges of streams. The leaves are from three to four inches long. The flower stalk reaches to the top of the water, where a yellow flower of about an inch in diameter is produced, and below which there is an inflated spathe which supports the flower at the surface of the water.

WATER HYACINTH (*EICHORNIA SPECIOSA* KUNTH).

The water hyacinth, known in Central America as the "Florida Devil" or "Million-dollar Plant," is a native of tropical America, and was introduced into South Africa as an ornamental pond-plant about 1910. Owing to the bladder-like floats at the base of the leaves, and the beautiful spike of mauve flowers which the plant produces, it has been introduced into many parts of the world and grown in tubs or garden ponds.

As might be suspected, the common names given to this plant in Florida were not given without cause. It grew so abundantly in the Florida rivers that all navigation was stopped until means had been found of clearing the water-course. It was estimated that to do this cost over a million dollars, and the plant became known as the "Florida Devil."

It is a perennial plant which is kept floating on the surface of the water by the inflated leaf stalks which contain air and act as floats. It sends out horizontal runners, from which new shoots appear, and eventually the new plants break away and continue as separate individuals. The flower stalk is about eight inches long and bears eight or ten pale mauve flowers in a terminal spike.

Under favourable conditions the plant multiplies at an alarming rate, and in many parts of the world it has been found necessary to proclaim it as a noxious weed and to enforce legislation for its control. In Ceylon and Burma vast sums of money were spent in an attempt to eradicate this plant, which not only stopped up the streams, but also the water furrows, so that irrigation became almost impossible. The difficulties encountered in eradication and the rapidity with which cleaned areas became re-infested led them to suspect that there was some other means of propagation other than that by runners from parent plants.

It was found that although the plants flower practically throughout the year, seeds were not produced except during a short period in the autumn.

The seeds are heavier than water and sink into the mud at the bottom of the furrows, where they can remain for as long as seven years, waiting for suitable conditions for germination. It would appear that the mud has to become dry for some time before germination takes place, but that when once germinated the growth of the young plant is very quick.

Methods of Control.—Numerous methods of control have been tried, including chemical sprays, etc., but no satisfactory means have been discovered, except actually removing the plants, drying and burning. Where rivers have become choked, it was found necessary to use the combination of a kind of saw and drags to remove the dense mat of plants produced.

It is useless to simply remove the plants, as even if dried for a lengthy period they will revive when thrown again into water.

Water Hyacinth in Southern Rhodesia.—The plant is well known in this country, and many people grow it in tubs or garden ponds because of the beauty when in flower. It has been seen at Bulawayo, Fort Victoria, Umvuma, Salisbury and Umtali. A few years ago it appeared in the Makabusi River, near the bridge at Parktown, and looked as though it would very soon completely block the river at one point.

An attempt was made to clear the river at this point, but it is now evident that the attempt was not successful. Judging by the experience in other countries, the danger of this plant should be realised, and steps should be taken immediately to eradicate it from rivers and water courses as soon as it is discovered.

Feeding Pens for Bullocks,

THE LAYOUT AT ESTES PARK, NEAR SALISBURY.

This Department is indebted to Mr. A. Miller, of Estes Park, through whose courtesy we are able to publish details of the feeding pens shown in the accompanying illustrations. These pens have proved remarkably efficient and cheap to construct, and the Division of Animal Husbandry recommends them as a pattern which might well be followed by other feeders of slaughter stock.

The structure consists of a double row of pens each approximately 35 feet wide by 48 feet deep, arranged as shown diagrammatically in figure 1. Pens of this size will comfortably accommodate fifteen polled animals or ten horned steers.

A general view of the pens is seen in fig. 2. The two rows of pens are divided by a central hay rack (seen in fig. 3), which consists of stout timber rails supported by railway sleepers and fencing standard placed alternately. The rails are 2ft. 6in. from the ground, and below them two strands of wire are stretched to retain the hay. The rack is 5ft. 6in. wide at the top, and is divided down the centre by a barbed-wire fence strained between the upright poles which support the centre of the roof.

Between each pair of pens is a substantial brick and cement feeding trough running the full depth of the pens, at right-angles to the hay rack (see figs. 4 and 5). These troughs are divided lengthwise by a wire fence strained between fencing standards or railway sleepers set in the structure of the trough. The troughs are 3ft. 6in. wide overall and 2ft. 6in. high, the inside measurements being 2ft. wide by 1ft. deep.

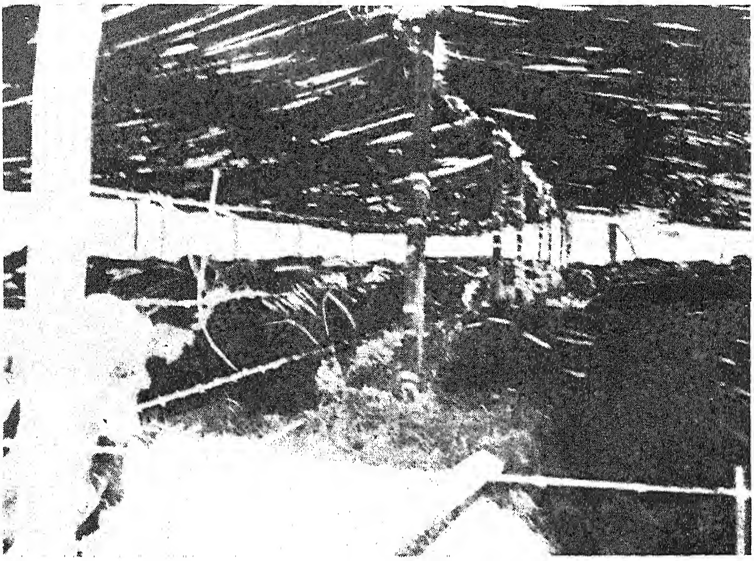


Fig. 3.—Looking along the central hayrack.

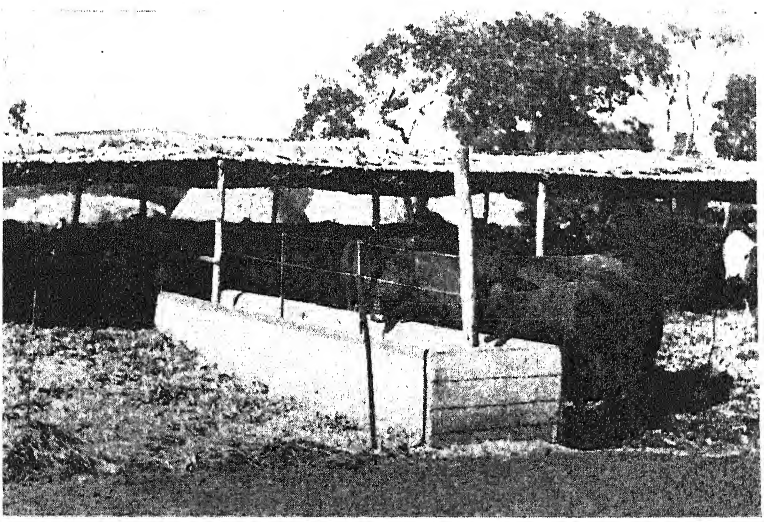


Fig. 4.—Brick and cement feeding trough between pens.

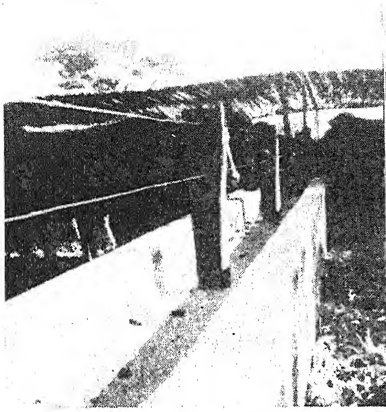
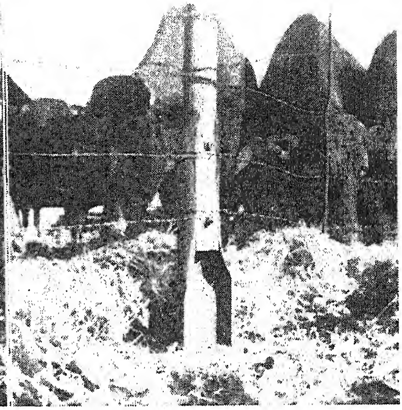
 

Fig. 5 (left).—Close-up view of trough showing dividing fence supported by sleepers.
Fig. 6.—Half-sleeper used as support for post.

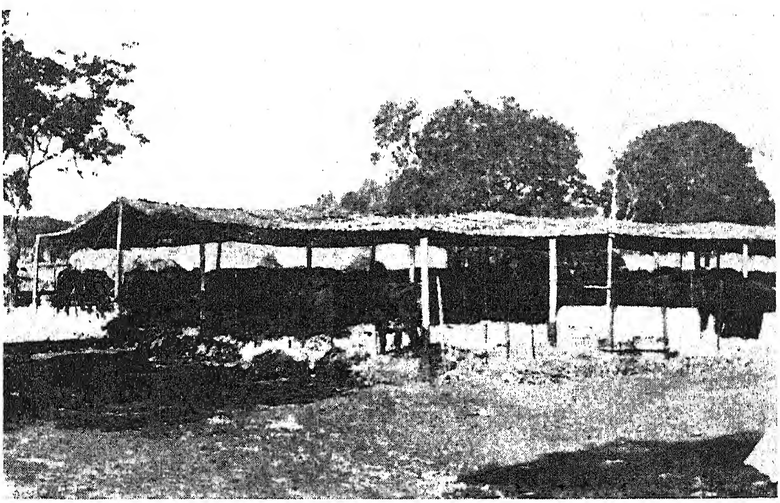


Fig. 2.—General view of pens.

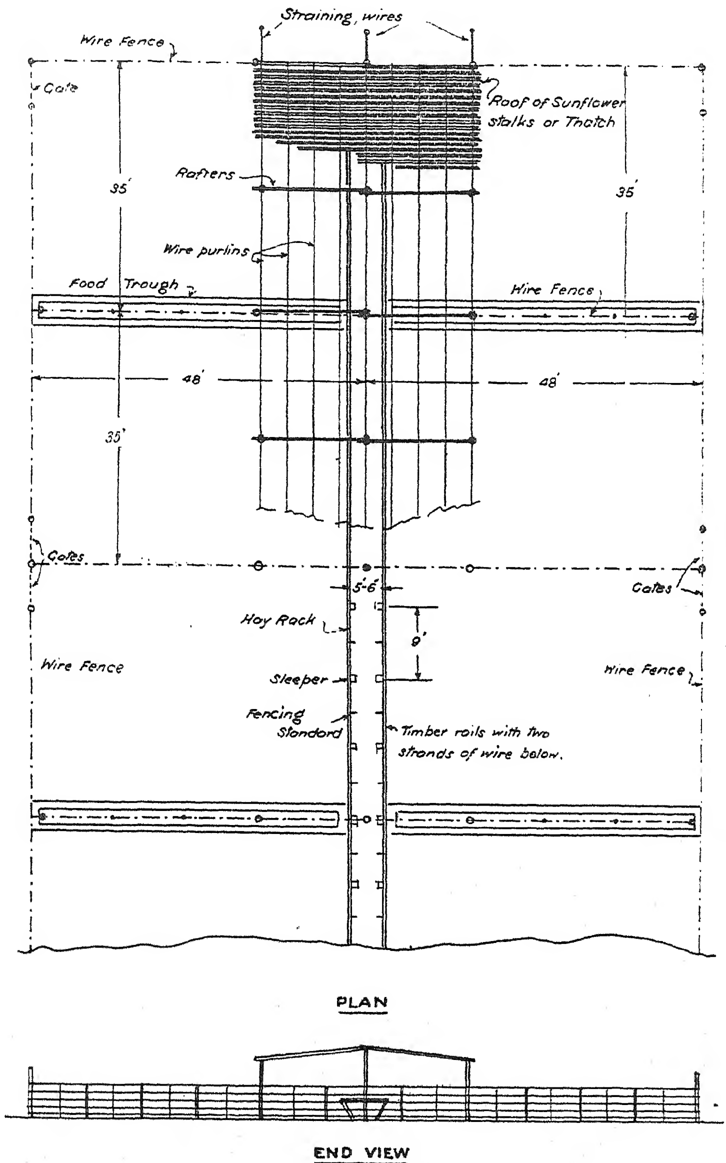


DIAGRAM
OF
FEEDING PENS FOR BULLOCKS
at
Estes Park nr. Salisbury.

Fig. I.

B.C.G.
24.7.37

Shade is provided by a light roof which covers the hay rack and extends 15ft. over each pen. The roof is 10ft. high at the centre, falling to 8ft. 6in. at the sides. The roof covering consists of sunflower stalks laced to wire purlins strained between the rafters, which are about 17ft. apart. In order to keep the wire purlins taught, the end uprights are anchored with straining wires secured to iron pegs driven into the ground about 4ft. 6in. away from the ends of the pens. If more convenient, a light layer of thatching grass might be substituted for the sunflower stalks.

As will be seen from the illustrations, the pens are constructed of barbed-wire fences supported by iron standards and timber posts. The method of anchoring these posts may be of particular interest, since it is one which would be suitable for a variety of structures of this nature. As will be seen in fig. 6, one half of a railway sleeper is forged round to fit the butt of the pole, to which it is secured by two half-inch bolts in such a way that the bottom of the pole is about 12in. above the ground, and is thus secure from attack by termites.

Each pen is furnished with a "concertina" type gate 6ft. wide, made of wire and fencing droppers.

The haystacks seen in fig. 2 are built close up on the windward side of the pens, and this affords shelter from the prevailing winds, and advantage has been taken of trees, where available, to provide extra shade.

The bullocks are taken out by pens each day for watering at a spruit about half a mile away.

A Programme for the Control of Diseases of Apple Trees
IN SOUTHERN RHODESIA.

By J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A.,
Senior Plant Pathologist.

With the extension of deciduous fruit planting which is taking place in the Colony, the question of the control of diseases becomes of economic importance, not only to the individual farmer, but also to industry which is now growing up.

It does not appear to be generally realised what damage is done to newly established orchards by certain diseases which are commonly found in most parts of the Colony. Because a tree makes rapid growth in its first two or three years and produces a satisfactory crop, there is no guarantee that it will continue to do so indefinitely unless precautions are taken to prevent invasion by diseases, which may eventually make fruit production unprofitable. With fruit growing, as with other phases of agriculture, prevention of disease is better than cure, and in a permanent orchard crop, once disease has become established, it cannot be eradicated by the simple and well-known process of uprooting and burning—so effective in an annual crop.

The adoption of a disease-controlling routine for all orchards is of first-class importance, but the measures recommended *must be carried out to schedule*, otherwise disappointment will be experienced and time and money wasted.

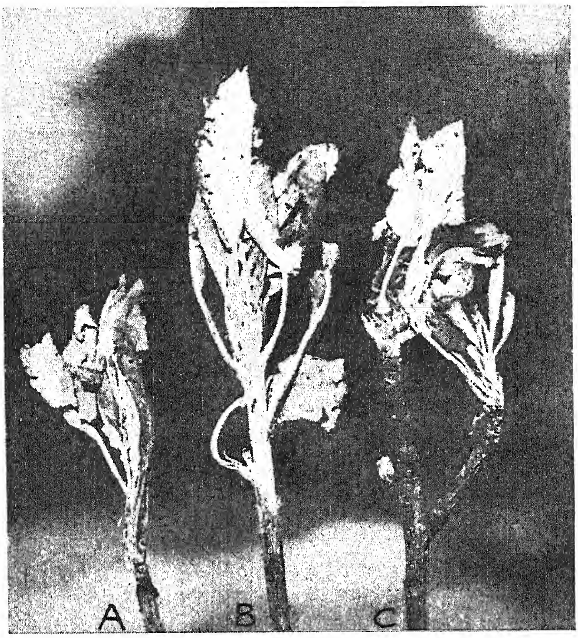
Owing to the demands made upon the Plant Pathological branch by other sections of agriculture, more particularly tobacco growing, no great attention has been paid to the diseases of deciduous and soft fruits in Rhodesia. From time to time, however, collections have been made and a number of fungi determined, whilst small experiments with fungicidal sprays and dusts have been carried out by some growers. The

information obtained from these preliminary investigations, coupled with the experience of research workers in the Union and other parts of the world, makes it possible for recommendations to be made for the control of the more common diseases which occur in Rhodesian orchards. It must, however, be understood that the most efficient spray schedules suitable for local conditions can only be evolved from local experiments technically supervised, but until facilities are available for such work, our knowledge of the life histories of the fungi causing disease in our orchards will form a useful foundation on which to build a defence against their invasion.

Recorded Diseases.—It is not proposed to deal in detail with all deciduous fruit diseases known to occur in Rhodesia, but in order that the importance of disease control may be stressed, it is advisable that the potential danger be made known. In this article it is proposed to deal with apples only, from which the following orchard diseases have been recorded(1): Bitter Rot (*Glomerella cingulata*), Black Rot (*Physalospora cydoniæ*), Branch Rot (*Schizophyllum commune*), Canker and Die-back (*Diaporthe perniciosa* [*Phomopsis mali*]), Blister and Fruit Cracking (*Coniothecium chomatosporum*), Die-back (*Valsa leucostoma*), Mildew (*Podosphæra leucotricha*), Pink Disease (*Corticium salmonicolor*), Root Rot (*Armillaria mellea*), Fly Speck (*Leptothyrium pomi*), "Fusicladium" or Scab (*Venturia inequalis* [*Fusicladium dendriticum*]), and a few minor troubles.

Four of the above appear to be well distributed throughout the Colony and have been collected from most commercial apple-growing districts. They are Bitter Rot, Black Rot and Canker, Blister and Fruit Cracking, and Mildew, of which by far the most serious, as far as can be ascertained, is Mildew. This disease can be very severe on susceptible varieties at elevations of 4,000 feet and under, and has been observed up to altitudes of 6,500 to 7,000 feet.

Symptoms.—Mildew may be recognised by the prominent symptoms it displays. The fungus attacks the new growth, inhibiting the development of the buds, and preventing much of the blossom from setting fruit. The young leaves do not grow out normally, but remain narrow at first, later becoming dried, shrivelled and curled. As the season progresses, the



APPLE MILDEW ON NEW TWIGS AND BUDS.
Note shrivelled and curled new leaves on A and C, and white mildew growth on new wood of B.

fungus grows on the surface of the new wood downwards towards the branches, and can be seen as a white coating on the new shoots, which are usually killed and the growth of the tree retarded. The occurrence of dried and shrivelled buds is a sure indication of the presence of Mildew, even though the white growth of the fungus may not be markedly noticeable. The general appearance of Mildew-infected apple twigs is shown in the accompanying photograph: A and C illustrate the dried-up and curled nature of the young leaf growth, and B shows the white coating of the fungus.

Black Rot, Blister, and BitterRot attack both the branches and the fruits, forming somewhat similar lesions, generally known as cankers, on the former. As the cankers enlarge, they gradually encircle the branches, which they cause to die-back from the tip downwards by preventing the normal flow of sap to the growing parts. Die-back may often occur without the presence of cankers on the stems, and is the result of invasion of the wood by a fungus, which usually gains entrance through a pruning wound.

The Blister disease, as its name implies, causes the formation of small, raised, irregularly shaped blisters in the bark of one- or two-year-old wood. They are not found so frequently on older wood and laterals, and are not always easy to detect on the young branches.

On the fruits these diseases may take the form of rots, cracking or russeting. Fruits affected by Black Rot show first of all small circular brown areas, which rapidly increase in size, and soon a firm, spongy rot affects the whole fruit. It eventually becomes black and shrivels up, remaining on the tree in the condition known as "mummied."

Bitter Rot first appears as a circular, light brown, depressed spot on the fruit, which seems to be mistaken by many growers for the "sting" of an insect. As the spot enlarges, the colour deepens, and very often concentric circles of light and dark brown may be seen in the rotted area, which is soft and not firm as with Black Rot. Later still, small spots, which may also be arranged in concentric circles or irregularly scattered, appear in the depressed region. The spots soon rupture to expose minute pink pustules, which are aggregations of the spores of the Bitter Rot fungus. The fruit

may finally become completely rotted, or only a part may be affected, and sometimes the disease does not appear until the apples are placed in storage.

Blister disease can be detected in most orchards by the appearance of cracks in fruit which has been infected at an early age. Russeting may also be due to the same fungus.

Life Histories of the Fungi.—A knowledge of the life histories of the fungi causing disease in orchard crops is of primary importance in formulating control measures. Where expensive spraying programmes and equipment are employed, an intimate knowledge of the mode of life of these tiny plant parasites is essential in order to avoid financial losses arising from waste of spray material applied at the wrong time of year. Fortunately, the life histories of the more common fungi are known, so that methods of control can be employed with confidence.

Mildew.—As stated earlier in this article, the Mildew fungus grows over the bark of new wood, covering it with a white felt, which consists of a densely woven mat of very fine threads. From these threads, tubes are forced into the surface cells of the apple twig, by means of which the fungus withdraws nutriment for its sustenance, at the same time killing the cells. Fortunately the fungus does not pentrate more deeply into the tissues of its host, and is therefore vulnerable to attack from outside the plant. However, some strands of the fungal mat, which grows over the shoots, penetrate beneath the scales surrounding the young buds and remain dormant during the winter months, only becoming active when bud movement begins in spring. The fungal strands commence to grow over the newly-formed leaves as they emerge from the opening buds, starting the disease up again. The fungus then continues to grow over the surface of the infected leaves, and soon produces millions of spores which give to the diseased areas the well-known powdery appearance characteristic of this type of mildew. These spores are scattered by wind and rain, and when they alight on a new leaf and conditions are favourable, they germinate and send out strands to form a fresh fungal mat, which grows down the leaf stalks on to the new shoots. If not removed, it remains dormant during the winter, only to initiate a fresh outbreak in the following spring.

Black Rot, Bitter Rot, and Blister Disease.—These three diseases may be conveniently classed together, as their life histories are somewhat similar. The fungi attack fruits, branches and leaves, causing rots, cankers and spots. Spores of the fungi are produced in these tissues, where they remain during the winter months to initiate new infection in the spring and summer, after being dispersed by wind and rain or by insects in a manner similar to that described for Mildew.

The principal difference between these three diseases and Mildew lies in the fact that Mildew grows only on the surface of the host plant, and is therefore more readily reached by fungicidal sprays, but the first three penetrate into the tissues of leaves, stems and fruits, and are unharmed by poisons which only reach the exterior of the trees. Thus it is possible to cure Mildew, but it is necessary to employ preventative methods against the other three. If these are unsuccessful, then resort must be had to surgery.

Control Measures.—In considering methods of control, the vulnerability of the separate fungi to standard fungicides must be ascertained. It is known that sulphur sprays or dusts are effective against Mildew, but not against Bitter Rot and Black Rot. Where Scab is serious, it is usually controlled by the sulphur sprays used against Mildew. Blister disease calls for an early application of Bordeaux mixture, and the whole programme needs to be combined with a scheme of insect pest eradication. The matter is further complicated by the susceptibility of most varieties of apples, in summer rain areas, to damage from copper sprays, whilst some varieties are also susceptible to sulphur injury. The adjustment of the concentrations of the ingredients of spray fluids is therefore a matter of very great importance.

Unfortunately, there is little local information at hand to assist in drawing up a comprehensive combined fungicidal and insecticidal spray schedule for apples, and care must be exercised to avoid severe damage to trees.

Trials carried out in summer rain areas of the Union* have shown that scorching of trees and russeting of fruit

*I am indebted to the Division of Plant Pathology of the Union Department of Agriculture for valuable information on this subject.

resulted from a combination of lime-sulphur and miscible oil applied during the summer, and the substitution of Bordeaux mixture for lime-sulphur would presumably have been worse.

A very early application of Bordeaux mixture is generally recommended against Blister disease, but subsequent applications of sulphur, which are necessary to control Mildew, may cause serious damage to trees under Rhodesian conditions, where a good deal of leaf and fruit development takes place before any rain falls.

It therefore appears that the use of Bordeaux mixture in a spraying schedule cannot be recommended until further trials have been made under local conditions. Furthermore, Bordeaux mixture is ineffective in controlling Mildew.

For the time being, it seems that a disease control schedule for Rhodesian conditions must be confined within the narrow limits of local knowledge. Mildew control is the first essential; after that must be placed Black Rot, Bitter Rot, and finally Blister Disease.

It is not proposed to recommend any spray programme for the control of the last three ailments. Black Rot can be brought under control by systematic removal and destruction during the dormant period of all diseased wood, dried or "mummied" fruits, which may be hanging on the trees or lying on the ground, and the collection and burning or digging under of fallen leaves. All such material is contaminated by active spores of the fungus, and if left in the orchards it will certainly spread the disease each year.

Bitter Rot appears when the fruit is about half grown, infection being derived chiefly from masses of spores borne by "mummied" fruits, either on the trees or on the ground. Cankers on the branches also produce spores which may infect fruit and young shoots during the summer months. The disease behaves in a manner similar to Black Rot, and can be checked by the assiduous removal and destruction of all infected wood and fruits during the dormant season. It does not, however, seem to be entirely eliminated in this Colony by such methods alone.

Blister Disease can also be checked by pruning, and as injured fruits are so easily recognised, they should be removed and destroyed as soon as they are seen, in order as

far as possible to eliminate spores of the fungus which are borne in the fruit cracks. Winter and spring spraying with lime-sulphur is also stated to check this disease in the Union(2).

In order to simplify matters, it may be said that considerable reduction in damage due to diseases will follow the careful removal and destruction of all cankers on shoots and branches, and all diseased fruits. Young branches should be cut back below the diseased areas at least three inches into the green wood. Cankers on old branches should be removed by cutting well into the healthy wood, dressed with a disinfectant, such as carbolineum, and painted with tar. All pruning wounds larger than a shilling piece should be treated in the same way. Where large branches contain cankers of long standing, it may be necessary to remove the whole limb in order to save the tree, but in many instances of this kind which have been seen, the better policy would be to destroy the tree itself, which only acts as a constant source of infection to its neighbours.

The control of Mildew presents many difficulties in countries where the disease is serious. For one thing, it is very persistent and difficult to eradicate once it becomes established in an orchard. It is possible to keep it at bay, and growers are urged to take all precautions possible to prevent Mildew from getting a grip on their young trees.

Here again judicious pruning and destruction of all visibly infected shoots and buds will remove a great deal of potential danger, but all infection is not likely to be got rid of in this manner, because of the presence of the previously mentioned strands of fungus beneath the bud scales. In order to inhibit growth and spore production from this resting fungus, a succession of sprayings is required to keep pace with the expansion of the fruit and leaf buds. As each lot of petals or leaves is unfolded and becomes exposed to infection, it is necessary to apply a coat of fungicide to kill the creeping strands of Mildew which extend over the newly formed tissues. Thus the disease is progressive and cannot be controlled by one spraying alone; nor do successive sprayings completely eliminate the disease, unless cutting-out is practised during the winter months.

It has been stated above that sulphur sprays are the most effective against Mildew, so that it now remains to devise a schedule of sulphur sprays which will give the best control of Mildew, whilst at the same time holding in check as many other diseases and pests as possible.

It has been found that lime-sulphur at 1 in 15 strength is effective, both as a fungicide and insecticide(5), and is recommended for use in the winter whilst the trees are dormant. Under Rhodesian conditions apple trees, particularly young ones, do not drop their leaves as rapidly as in more temperate zones, and it is inadvisable to delay the strong lime-sulphur wash until all leaves have fallen. The application must be made before bud movement begins. In Rhodesia and many other countries a miscible oil is recommended for mixing with the lime-sulphur as a dormant spray(5), and this increases its insecticidal value against scale, mites and woolly aphis. As the last named occurs only rarely in Rhodesia, good results are obtained with lime-sulphur alone.

Unfortunately, many growers imagine that this single application also controls Mildew and other diseases, but as has been explained, this is not the case. Additional spring and summer sprayings are required, which *must* be applied at the correct time. Spraying times are given according to the stages of development of the new buds, thus:—

Dormant Season . .	Approximately June till August, between leaf fall and bud movement.
Bud Movement	When the buds start to swell, before any leaves appear.
Open Cluster	When the blossom buds are visible and slightly separated from each other.
Pink Bud	When the pink colour of the petals is visible, but before the blossoms open.
Petal Fall	When the majority of petals have fallen, but some still remain on the trees.

Lime-sulphur alone is not a good deterrant of Mildew; it has been shown by a number of workers that more efficient control is obtained when powdered or colloidal sulphur is present in the spray fluid. In some cases, sulphur dusts are preferred. Cunningham(3), in New Zealand, more than ten years ago, recommended the use of precipitated sulphur, but in a more recent paper(4) has stated that colloidal sulphur mixed with lime-sulphur gives a good control of Mildew without damaging the fruit, when used as a summer spray. Other workers in Great Britain, America and elsewhere have noted the greater tolerance of sulphur-susceptible varieties of apples to colloidal sulphur sprays, and it is a pity that little information is available regarding the suitability of this substance under African conditions.

Several brands of sulphur fungicides suitable for apple-spraying are marketed in Southern Rhodesia. Messrs. Cooper & Nephews (S.Af.) Pty., Ltd., manufacture the "Capex" brand of "Special Sulphuring Dust," a colloidal sulphur, called "Capoidal Insecticide," and liquid and powdered lime-sulphur. The dust is not readily wettable, and does not remain long in suspension when added to the spray fluid. Their lime-sulphur is of standard strength and is used by most growers. The same firm markets a miscible oil called "Pestridol," which can be mixed with lime-sulphur and colloidal sulphur. "Olite" sulphur dust, which is particularly finely ground and gives a very good dust cloud, has been sold in the eastern districts, and is presumably still stocked by certain merchants. This dust has the advantage of being readily wettable and remains well in suspension when mixed with a liquid spray. "Sulsol," a colloidal sulphur manufactured by the makers of "Olite" sulphur, has also been used in this Colony, but does not appear to be stocked regularly by merchants. Other sulphur fungicides appear from time to time, but are not in general use.

Growers who wish to revise their spraying programmes this coming season would, therefore, do well to ascertain immediately if their requirements can be met locally.

In view of the fact that colloidal and wettable sulphurs have been used in Rhodesia and can presumably be obtained without undue difficulty, the following schedule is recommended for apple growers:—

Time of application.	Procedure.
Dormant Season . .	(1) Cut out and burn or bury deeply all diseased wood showing cankers or die back. Collect all "mummied" fruit from trees and ground, and destroy. Where possible collect and burn or dig in fallen leaves. (2) Spray with Lime-sulphur 1-20, + miscible oil, according to manufacturers' directions.
Between open cluster and pink bud . . .	Lime-sulphur 1-30.
Petal Fall	Sulphur dust, or Lime sulphur 1-100 +(colloidal sulphur 1½lb. per 100 gals., or wettable sulphur 8 lbs. per 100 gals.)
Two weeks later . .	Ditto.
At monthly intervals where necessary . .	Ditto.

Spray Equipment.—The large grower will need mechanical equipment, the choice of which is not the subject of this article. For the small grower, however, an inexpensive equipment can be obtained locally. Bucket pumps have given satisfaction where used, but should be fitted with about 12 feet of hose terminating in a brass tube extension having an angle bend and a fine spraying nozzle. The usual type of bucket pump sold with the so-called "Bordeaux" nozzle is extremely handy for washing motor cars or other domestic uses, but is quite unsuitable for spraying trees, or, for that matter, any plant, against fungus diseases. A fine mist-like spray is essential in order that the fungicide may penetrate into all small cracks and crevices, whilst a reasonably good pressure is required, especially for summer spraying, in order that the fluid may penetrate to the centres of the trees. If sufficient length of hose is provided, so that the tree may be sprayed from all sides without moving the bucket, it will be found that the work can be carried out thoroughly and at a reasonable speed.

A word of warning should be given here. Be sure you provide yourself with a *fine spraying nozzle.* Do not accept *lime-washing* or *adjustable tap nozzles* as substitutes.

Where sulphur dusts are used, a good type of knapsack dusting machine should meet all the requirements of the local grower. The dust should be applied in the late afternoon or evening when the wind has dropped, and the machine should be operated in such a way that a good cloud of sulphur is formed some feet away from the tree on which it is allowed to drift gently. A heavy coating of sulphur is wasteful and liable to cause damage, especially to trees in leaf.

As a final word of warning, it should be stated that as our knowledge of the effects of summer sprays on apples in Rhodesia is very meagre, growers should experiment at first on a few trees of each variety, in order to ascertain those which are susceptible to sulphur injury.

Information on this point will be welcomed by the Plant Pathology branch of this Department.

The question of the advantages or disadvantages of pruning apple trees in Rhodesia is not a matter for discussion in this article. Whichever method is practised, the fact remains that the cutting out of diseased wood is an essential part of any orchard routine.

SUMMARY.

1. Attention is drawn to the fact that deciduous fruits, more particularly apples, are subject to attack in Rhodesia by a variety of well-known orchard diseases caused by fungi.

2. Mildew, Black Rot, Bitter Rot, and Blister disease, being the most commonly encountered, are described.

3. The life histories of the fungi causing these four diseases are discussed in relation to measures recommended for their control.

4. A disease control schedule for apple growers in Rhodesia is suggested.

5. The importance of employing the right kinds of spray materials and equipment is stressed, and a warning is given to experiment in a small way at first with summer sprays, in order to ascertain which varieties of apple are susceptible to sulphur injury.

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The Rhodesian Home Orchard.

By G. W. Marshall, Horticulturist.

Introduction.—In this article it is proposed to deal mainly with the general purpose or utility orchard for the farm or town plot in which the owner wishes to plant a selection of fruit trees to meet the household's fruit requirements.

Fruit may be regarded as an essential part of our diet, and if we wish to maintain good health an endeavour should be made to produce throughout the year a regular supply of fruit. This is possible in many districts of Rhodesia, for we have a wide range comprising tropical, sub-tropical and temperate fruits to choose from, and with judicious selection a sequence of fruits may be produced to furnish the home requirements from January to December.

A comparison of existing home orchards in Rhodesia is enlightening. They vary from exceptionally good to extremely poor. In the former case there is evidence of a natural love for orchard management, the trees are well tended, the fruit crops are good in quality and quantity and are a real joy to the owner. In other orchards are trees planted carelessly, neglected and an eyesore to all who see them. Many of these failures are due to lack of knowledge concerning the planting and subsequent cultural requirements of the trees, to planting of varieties unsuitable for the purpose they were intended to fulfil or to the planting of more trees than were actually required or could properly be attended to.

An endeavour will be made in the succeeding pages to deal with the many factors that need consideration when establishing and maintaining a home orchard, and it is trusted that the advice tendered will be of assistance to those about to establish, extend or improve their orchards.

Selection of the Orchard Site.—The most important factors to consider when selecting a site for a home orchard are suitability in respect to—

(1) soil;
(2) shelter;
(3) aspect;
(4) irrigation possibilities; and
(5) distance from homestead.

If one or more of these factors are disregarded, poor and unprofitable fruit may very well be the result.

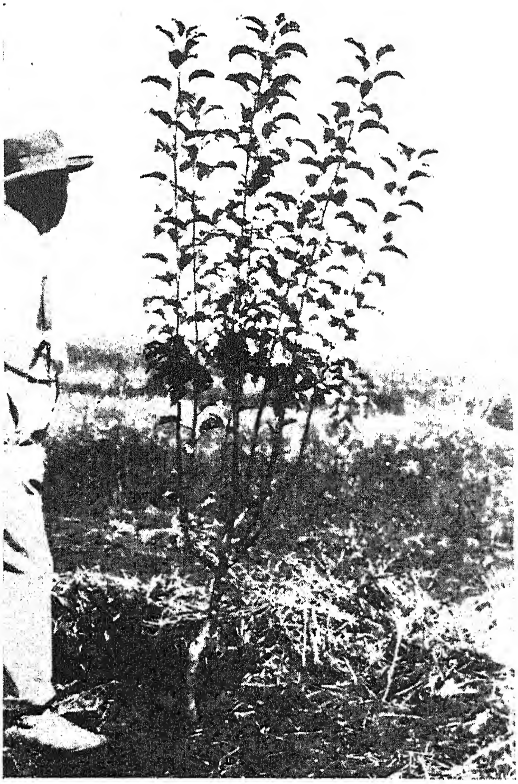
Soil.—The best soil for the profitable production of most fruits is a light to medium loam with good depth and drainage. Suitable soils as described above will furnish the trees with a large root-feeding area, the trees will be capable of growing to a good size, living to a great age and producing large crops of good fruit. If there is no soil of this nature available it then becomes necessary to be content with a heavier soil. Heavy soils, however, are undesirable; they are more difficult to work, and the quality of the fruit they produce is often poor, particularly during the wet seasons, and they should be avoided if lighter soils are available.

On shallow soils with impervious sub-soils young trees may thrive and flourish for a few years, but when the roots encounter the objectionable sub-soil the trees will rapidly decline or die and prove a great disappointment to the owner.

The minimum depth of a good fruit tree soil should be not less than four feet, and to this depth the land should be naturally well drained. Soils containing small stones throughout their entire depth or those overlying gravelly sub-soils are suitable for tree-planting, provided the tree roots are able to penetrate to the requisite depth, namely, four feet or more.

Shelter.—Owing to the harmful effect of dry winds during spring or the blossoming months upon the setting of the fruit, it is imperative that all orchards should be adequately protected from such winds. Having selected a suitable soil for the orchard, shelter belts, unless already existing naturally, should be established without delay. It is to the advantage

Desirable shelter of cupressus. An outer row of tall trees would furnish better results. These trees are too near the citrus trees.



Second year's growth. Apple Tree on Seedling Root.

of the fruit trees if shelter belts which are required to be established are planted a few years in advance of the orchard they are to protect.

Young fruit trees require protection from the time of planting if the best results are to be assured. This is not always feasible, however, particularly with new arrivals to the country who desire to establish orchards without unnecessary delay. In instances such as this the shelter trees should not be planted later than the fruit trees they are to protect, and meanwhile rows of some of the more quick-growing temporary shelter plants may be grown at close intervals around and through the orchard to afford temporary protection until the permanent trees become effective.

When the orchard is enclosed, as it should be, by wire netting or fencing to exclude domestic animals, small buck and ground vermin, a temporary shelter can quickly be produced by planting granadilla vines at ten feet intervals along the fences; when the vines have covered the fence a few additional strands of wire may be erected above to enable the vines to form a screen of at least six feet in height. Other creepers may be used in place of the granadilla, but the latter is preferable, as it produces an edible fruit. Bananas and platains are useful shelter plants; they grow quickly and produce good fruit. Dhal also is useful for a temporary hedge, the foliage and grain being valuable poultry food.

The best time of the year to plant all shelter trees is during the months of December and January; by planting at this season, when rains are usually frequent, it should be possible to establish the trees before the dry season commences. It is seldom necessary to plant shelter trees on more than three sides of the orchard, the idea being to exclude the prevailing hot and dry winds that are prevalent from July to November. The sides of the grove usually requiring protection are the south-east and north-west, as it is from these directions that most of the winds are experienced. If the west, south and east sides are protected, little or no tree or fruit injury will occur. No shelter trees should be planted nearer than 60 feet to 70 feet from the fruit trees; this distance appears to be ample for Rhodesian requirements.

The varieties of trees recommended for shelter belts are:—Tall-growing trees for outer rows—*Eucalyptus tereticornis* and *Eucalyptus saligna;* the latter do best at the higher elevations. If eucalyptus trees are objected to and the soil is sufficiently light, *Pinus radiata* will be found suitable for the outer rows, and for the inner rows, *Cupressus torulosa* and *Cupressus lusitanica*, but the last named only where the rainfall is heavy or irrigation is possible.

Many other varieties are suitable and may be planted, but those specially mentioned will furnish a range to select from for average climatic conditions.

When two or more rows of trees are planted to form a shelter belt they should be spaced 8 feet apart in the rows and 10 feet between the rows. "Staggered" trees give the best results, *i.e.*, like the teeth of a saw.

Aspect.—The best aspect to select for the orchard is one with a gentle southern and eastern slope. Northern and western aspects are often undesirable. The slope of the site should not be excessive, or soil erosion will be liable to occur during heavy rain storms or irrigation. The best slope will vary with the nature of the soil, but it should never if possible exceed one in a hundred.

Irrigation Possibilities.—Preference should be given to a site capable of being irrigated by gravitation, provided the shelter, soil and aspect factors are right. Good fruits may be grown in Rhodesia without irrigation, but if irrigation can be made available, so much the better.

Distance from Homestead.—The orchard site should be as near the homestead as possible, but the other factors must not be disregarded when making the choice. Orchards distant from the homestead are more liable to be neglected, cannot be kept under such close supervision and are subject to greater losses through depredations by birds and by theft.

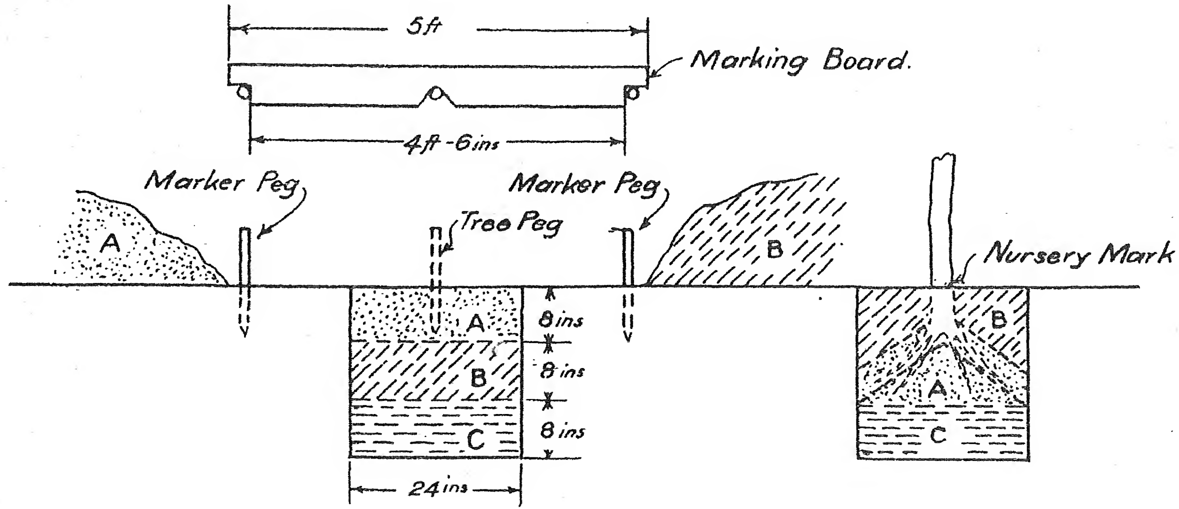
Preparation of Land.—After the selected site has been cleared of its timber, etc., it should be deeply ploughed and brought into good tilth; this is possible if performed towards the end of the rainy season—about March. When the ground

is prepared at this season most of the soil moisture will be conserved and the later operation of digging the holes will be made easier. When irrigation is possible it is also necessary to give careful attention to the problem of how the proposed site can best be irrigated. In such cases the advisability of grading the land before the trees are planted cannot be too strongly emphasised, as the efficiency of the irrigation scheme so much depends upon the proper grading of the site. After grading, the whole area should be re-ploughed, cultivated and brought into the best possible condition, and if it can be arranged a local irrigation should be given to ascertain which fall will be most suitable for planting the rows. The rows should preferably be short, with not more than 15 trees to each row. Such rows would be 120 yards in length and the fall should be about 6 inches per 100 feet, according to the nature of the soil; sandy soils require a greater fall than those of a medium or heavy character. When trees are planted on an ungraded soil continuous trouble will confront the grower, and is it is neither easy nor economical to grade the slopes of an established orchard, this work should be done prior to planting. The additional cost of a properly graded site is more than justified on account of the ease with which all of the cultural and irrigation operations may be performed. On ungraded slopes the trees will receive irregular supplies of water, and this in turn will necessitate more frequent irrigation. Depth of ploughing will also be uneven; silting will occur in the depressions, thereby endangering the health of many of the trees.

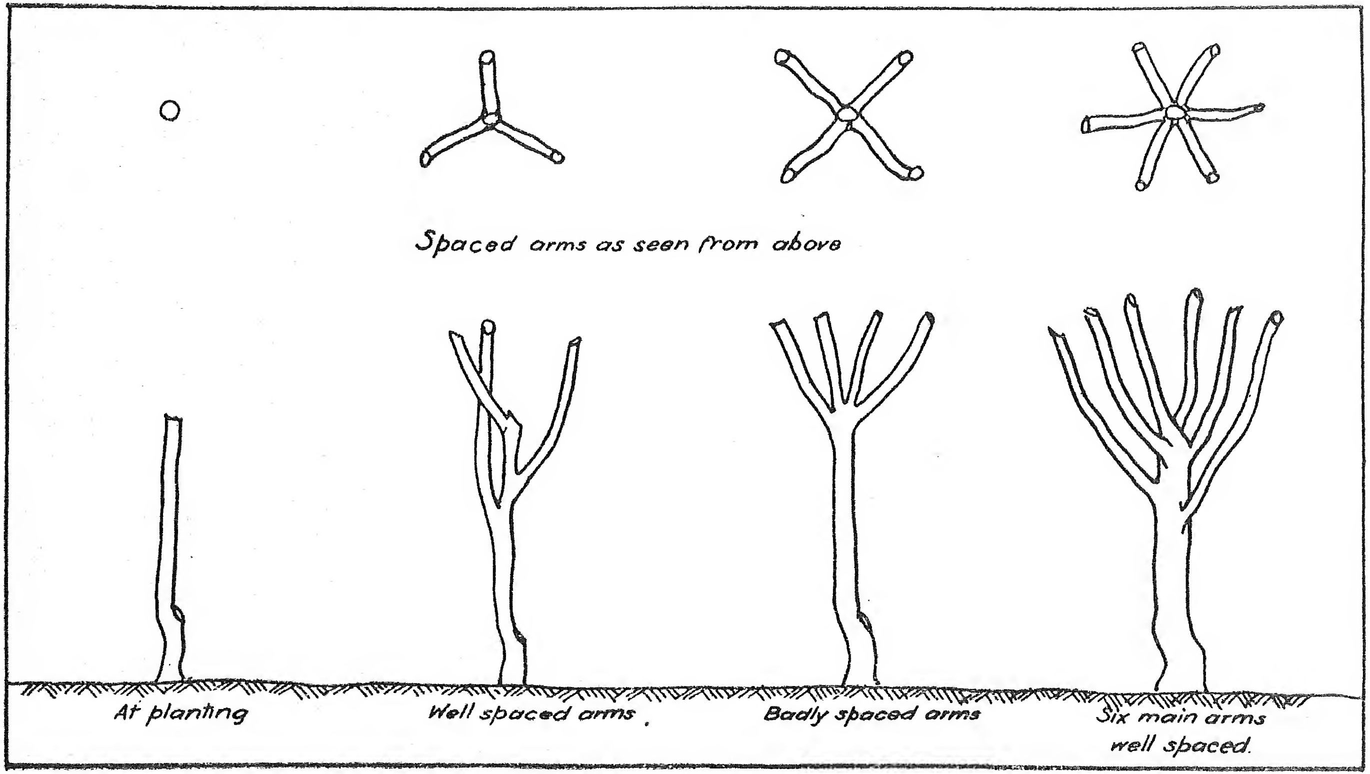
Laying out the Orchard.—After preparing the chosen site in a thorough manner it should be carefully laid out with the rows of trees planted along the contours, where necessary, allowance being made to permit of the irrigation water flowing evenly without displacement of the soil. The necessary appliances for the pegging out of the site are:—

A planting wire or strong garden line to set about six pegs at a time (42 yards). For this purpose No. 16 galvanised wire could be used, and lumps of solder or rings of wire should be connected at the distances apart it is intended to space the trees. A 3-inch ring must be attached to each end of the line 3 feet from the end solder mark. This facilitates

TREE PLANTING DIAGRAM



Drawn in Irrigation Office



Drawn in Irrigation Office

the adjusting of the wire to its position when the pegging operation is proceeding. Two half-inch iron pins 18 inches in length will be suitable to hold the line in position while the marker pegs are being set. Sufficient wooden pegs 12 inches to 18 inches in length and about 1 inch in diameter should be available to allow three pegs for each tree to be planted.

The square system is the best for the laying out of the orchard, as it facilitates all cultural operations, chiefly on account of the wider middles (space between the rows of trees). It permits of ploughing and cultivation being carried out in four directions, and each tree has a greater root-feeding area than that obtained in other systems of planting.

The procedure to adopt when pegging the site is as follows:—Set the first line of pegs parallel but at least 60 feet distant from the windbreak, provided the fall is suitable for irrigation. When the base line is completely pegged the end lines should then be set at right angles to it and then pegged. The unpegged side should next be checked to ascertain if it is the same length as the base line, and if it is found to be incorrect it will then be necessary to adjust one end line to correct the error. The fourth side may then be pegged. We now have the site completely enclosed with the outer row pegs. Presuming that a six-peg wire is being used, it will then be necessary to peg every sixth line parallel to the base line; when this is completed the filling in will be simple. The line should be set between the base line and sixth row pegs and the four intervening pegs set. This filling in is then repeated until the end of the section is reached, after which the marking wire should be set from the sixth row to the eleventh row peg and the four inter-venings pegs set; this filling in process is then repeated until all pegs are set.

After the area is completely pegged, and if it is intended to dig the holes at once, the whole site must be doubly pegged to permit of digging the holes where the tree pegs stood. This pegging is simple if a suitable marking board is made as illustrated in Fig. I. The second pegging may be commenced from any corner of the site and can be continued row by row until completed.

Place the central notch of the marking board close against the tree peg, then set the two marker pegs in the end notches of the board, which may then be moved to the next peg, when the process is repeated until the site is completely double pegged. The tree pegs may be left standing, as they assist the hole-digger to locate the exact spot the tree is to occupy.

Digging the Holes.—All tree holes should be dug if possible several weeks before the planting of the trees is begun, and when this is possible the holes should be refilled with good soil soon after digging is completed to permit of the earth settling down, and thus eliminating the danger of the trees sinking too deeply, as is often the case where trees are planted immediately after the digging of the hole. The size of the holes for the trees should be at least 2 feet *square* (not round) and 2 feet deep.

The digger must first mark the size of the hole round the tree peg before withdrawing it. He should then dig out 8 inches of surface soil and place it on a site unoccupied by a marked peg. The second 8 inches of soil is then placed on the opposite side of the hole and the bottom 8 inches of soil is loosened and left in the hole. This procedure is best for soil of good depth and quality.

If the sub-soil is inferior to that of the surface soil the first 8 inches of soil should be placed as previously suggested and the remaining 16 inches be dug out from the hole and discarded, the hole being then two-thirds refilled with good surface soil collected from near by, the 8 inches of surface soil previously taken out being used to complete filling. When hard-pan is encountered it is advisable to break it with dynamite (agricultural). The explosion will shatter the hard-pan to a great depth and allow roots to penetrate in all directions. When dynamite is correctly used a pot-hole will be formed where the explosion took place; this hole should be closed and firmed, otherwise trees planted above it will gradually subside and eventually stand in a deep basin. This condition is very undesirable owing to water accumulating round the stem of the tree after irrigation or rain.

Planting Distances.—For best results most varieties of fruit trees should be spaced at certain specified distances. This is possible in commercial plantings, where large numbers of a fruit variety are planted. In the home orchard it is different, as often fruit trees that require various espacements must be planted in a small area. This difficulty may be overcome by arranging the varieties in such a manner that the short-lived trees may be rooted out when their neighbours or larger-growing trees require the additional space. Suitable distances for planting fruit trees are as follows:—

Variety.	Distance apart each away.
Pecan nut and walnut	48 ft.
Seedling orange and seedling Avocado pear, grafted orange, lemon, naartje, Tahiti lime, grape fruit, litchi, guava and pear	25 ft.
Almond, quince, West Indian lime, plum, peach, apple, apricot, nectarine, fig, cherry, custard apple, persimmon	20 ft.
Paw-paw, banana, plantain, tree tomato and Chinese guava	10 ft. to 12 ft.

It is not necessary or possible to plant the assortment stated, but it is often necessary to plant a mixture of trees requiring different espacement, which may be arranged as follows:—

N 12 ft.	T 12 ft.	S 12 ft.	T 12 ft.	N 12 ft.	T 12 ft.	S
T	T	T	T	T	T	T
S	T	S	T	S	T	S
T	T	T	T	T	T	T
N	T	C	T	N	T	C
T	T	T	T	T	T	T
C	T	C	T	C	T	C

N denotes Pecan nut trees ...	48 ft. apart.
S denotes Stone fruit trees ...	24 ft. apart.
C denotes Citrus trees	24 ft. apart.
T denotes Paw-paw trees ...	12 ft. apart.

The average profitable life of these trees would approximately be: Pecan nut 100 years, stone fruit 10 years, citrus fruits up to 30 years or over, paw-paw 5 years.

From the profitable ages given it will be seen that all the T's could be removed after the fifth year, thus giving additional space to the N's and S's. The S's would then be removed at the end of the tenth year to provide the N's with sufficient space to develop fully. This system of interplanting short-lived trees between trees that grow to a large size and live to a great age is to be commended as the most satisfactory method for the lay-out of the home orchard.

Ordering of Trees.—When purchasing fruit trees for planting they should be ordered well in advance of the planting season. It is best to buy the trees from reputable nurserymen who raise good and healthy trees from selected parents. First-sized trees only should be used; smaller trees are often undesirable and seldom give good results.

Time of Planting.—Deciduous fruit trees should be planted when they are dormant (have shed their leaves), the best months being June and July: the later month is somewhat late for many varieties of sub-tropical peaches, and these should, according to circumstances, be planted in June or even as early as May.

Citrus and other evergreen fruit trees may be planted at any season of the year, provided irrigation facilities are available and the trees are not in active growth. When only a few trees are to be put out, and assuming they are procurable, August is as good a month as any in which to plant. Given good attention and a full growing season, August-planted trees will out-grow those planter later in the year. For extensive plantings, however, the rainy season should be chosen, for then there is less danger of losses amongst the plantings. January is the best month if the trees are dormant. Trees planted this month will do better than those planted later, as they are more capable to withstanding any unfavourable climatic conditions which may occur during the following winter.

Choosing Varieties to Order.—For the home orchard it is advisable to select, as far as possible, varieties that are known to do well in the locality in which it is intended to plant, Well established nurserymen are often the best advisers in this respect, for they make a speciality of raising trees that do well in particular districts, their advice being based on repeat orders received from these areas.

Southern Rhodesia produces fruit ranging from temperate to tropical, for in the tropics high altitude gives large sections of country with a temperate climate. It is, however, advisable to plant most varieties that are known to thrive and yield fruit under sub-tropical conditions. It is also well to plant varieties to give, if possible, a sequence of fruit throughout the year. With the home orchard, owing to the greater variety of fruit trees planted, there is seldom the necessity to consider inter-pollination. When a few varieties of each fruit are planted, pollination is usually good. Fruits such as the Ohinemuri apple, Doyenne du Comice pear and most almonds are self-sterile, *i.e.*, they are incapable of pollination with their own pollen. Sometimes the male and female flowers mature at different periods and this prevents natural pollination. Walnuts also are often affected in this way. To counteract this difficulty the Ohinemuri apple tree must be planted next to the White Winter Pearmain apple, Comice pear next to the Beurre Bosc, and the Wickson plum next to Kelsey. This inter-pollination is to be considered more by the commercial planter than the home orchardist but even by the latter it should not be disregarded.

The commercial grower in the past often planted pure blocks of one or more of such varieties, with disastrous results. When these blocks of one variety were grafted to two or more varieties blossoming at the same time, alternative rows having been cut down and re-grafted, the trees started bearing as soon as the top-worked trees blossomed.

For the guidance of new growers, a list of suitable fruits is here given for the different elevations of Rhodesia :—

FRUIT VARIETIES FOR RHODESIA.

E—Indicates Early Variety.
M—indicates Mid-Season Variety.
L—Indicates Late Variety.

	Tropical Under 400 ft.	Sub-Tropical 4—5000 ft.	Temperate. Over 5000 ft.
Apples	Rome Beauty ... L	Rome Beauty ... L Versfeld... ... ... L Carrington (Alma) ... ... E American Lady (Xmas)... ... E	Rome Beauty ... L Versfeld... ... ... L Rhode Island Greening ... L Ohinemuri ... ... L Jonathan ... ... M Blenheim Orange Pippin ... ... M Delicious ... ... M
Pears		Keiger Hybrid L le Comte ... ... M	Keiffer Hybrid L le Comte ... ... M Clapp's Favourite E Bon Chretien ... E Beurre Bosc ... M Glout Morceau L
Quinces		Cape Selected Meeche's Prolific Champion	Cape Selected. Meeche's Prolific. Champion.
Peaches ... ... Y indicates yellow flesh.	Killiecrankie ... E Waldo ... ... E Angel ... ... M	Killiecrankie ... E Bell's November E Watt's Early ... E Jewel ... ... E Brook ... ... M.Y. Florida Gem ... M Florida Crawford M.Y. Shackleford ... M	King Edward VII. E Oklahoma Queen E Duke of York E Florida Crawford M.Y. Early Crawford M.Y. Mamie Ross ... M St. Henena ... L.Y.
Nectarines...			Early Rivers ... E Gold Mine ... ... M
Plums—			
Red Flesh	Satsuma... ... ... M Santa Rosa ... ...E	Santa Rosa ... ... E Satsuma ... ... M	Santa Rosa ... ... E Satsuma... ... ... M
Pink Flesh		Beauty ... ... E	Beauty ... ... E
Yellow Flesh ...		Wickson... ... ... M Kelsey L	Wickson... ... ... M Kelsey ... ... L Burbank... ... ... M
Apricots		Alpha... ... ... E Early Cape ... ... E	Alpha ... ... E Early Cape ... ... E
Figs	White Genoa.	White Genoa Adam	White Genoa Adam

	Tropical Under 4000 ft.	Sub-Tropical 4—5000 ft.	Temperate. Over 5000 ft.
Walnuts		Japanese	English
Pecan Nuts	Success. Stuart	Success Stuart	Success Stuart
Almonds			Britz Jordon I.X.L. Paper Shell
Cherries			Belle of Orleans Napoleon Black Tartarian
Oranges	Washington Navel E Premier (Joppa) M Valencia Late ... L Seville (Marmalade)	Washington Navel Premier (Joppa) M Valencia Late ... L Seville (Marmalade)	
Grape Fruit	Triumph	Triumph	
Naartjes	Old Cape Emperor	Old Cape Emperor	
Lemons	Eureka Villa Franca	Eureka Villa Franca	
Lime	Tahiti	Tahiti	
Other Citrus ... ... (for preserves)	Kumquat. Pompelmoes	Kumquat Pompelmoes	
Avocado Pears ...	Selected Seedling Budded Fuerte. Budded Spinks Budded Gottfried Budded Linda	Selected Seedling Fuerte Spinks Gottfried Linda	
Mango	Selected Seedlings Kidney Peach	Selected Seedlings Kidney Peach	
Litchi	Layered Trees	Layered Trees	
Custard Apple ...	Seedling Cherimoier	Seedling Cherimoier	
Guavas	Dwarf Strawberry Selected Seedlings	Dwarf Strawberry Selected Seedlings	
Loquats	Selected Seedlings	Selected Seedlings	
Mulberry	Hick's Everbearing	Hick's Everbearing	English
Persimmon		Most varieties	

	Tropical Under 4000 ft.	Sub-Tropical 4—5000 ft.	Temperate. Over 5000 ft.
Banana...	Ducasse Hybrid Custard Lady's Finger	Ducasse Hybrid Lady's Finger	
Crape Vines	Catawba	Catawba White Hanepoot Red Hanepoot Barbarossa Crystal	Catawba White Hanepoot Red Hanepoot Barbarossa Crystal
Other Fruits	Vumba Strawberry Tree Tomato Pineapple (Cayenne) Paw-Paw	Vumba Strawberry Tree Tomato Paw-Paw Raspberry (Red Cuthbert)	Vumba Strawberry Blackberry Raspberry (Red Cuthbert) Loganberry

Description of varieties will be found in nurserymen's catalogues.

(To be continued.)

Annual Report of the Chief Animal Husbandry Officer

FOR YEAR ENDED 31st DECEMBER, 1935.

By A. E. Romyn, Chief Animal Husbandry Officer.

[Note.—*The publication of this report was delayed owing to pressure of space.*—Ed.]

CATTLE INDUSTRY.

Despite the restrictions on export, due to foot and mouth disease, and the winter losses from poverty in Matabeleland, the cattle industry has weathered the year well and is superficially in a more hopeful position than at the end of 1934.

The improvement is due to the export overseas of 83,000 head of cattle and to the removal of the bulk of the remainder of the available surplus in Matabeleland by drought losses. It is anticipated on these accounts that the prices for cattle will be higher in 1936 than during the present year.

The cattle in Mashonaland generally wintered better than for a number of years.

EXPORT TRADE.

1. **Chilled Beef.**—The returns on the chilled beef exported during 1935 were approximately the same as those obtained in 1934, except for the period from about the middle of June to the middle of August. During these months prices sank to a slightly lower level than any reached by beef from this Colony during 1934. The prices for stall-fed cattle during the earlier part of the year were poor and did not pass the 1934 level until September. The prices for chilled beef continue to be unremunerative, and the trade can only be carried on with the assistance of the bounty on beef exported. In the present unsettled condition of world trade, it is still impossible to make a definite pronouncement as to the future of this trade.

The low prices realised in June, July and August are a repetition of what occurred in 1934. In future years, therefore, it would seem advisable to make definite arrangements to curtail shipments of beef to arrive in the United Kingdom during this period. An arrangement should also be come to whereby a certain proportion of the forequarter beef should either be boned or converted into meat meal when the price of forequarters sinks below the cost of export.

The Rhodesian Export and Cold Storage Company are to be congratulated on the year's working. In the peak months the monthly killings exceeded 6,000 head of cattle. This output exceeds the most optimistic forecast made in 1934.

A remarkable feature of the export trade in chilled beef this year has been the increase in the number of stall-fed cattle exported. Approximately 16,000 stall-fed cattle were exported, as compared with 5,000 in 1934. The feeding of cattle for export has become a general practice, and a large number of small farmers in Matabeleland are now reconciled to feeding bullocks. A general improvement was noticed in the methods of the older feeders, and in the course of a year or two it is likely that the general level of feeding for export will be very good.

The difference of opinion between the rancher and the feeder as to the value of store cattle continues. The ranchers are demanding a higher price for store cattle than the feeders are prepared to pay. As a result of this impasse, most of the ranchers arranged to draw "rebate maize" from the Control Board and feed the greater proportion of their own bullocks. There is likely to be the same shortage of stores for feeding in Mashonaland during 1936. The matter will find its own level before long, and in the meanwhile there is a tendency for feeders in Mashonaland to buy younger stores and keep them for one or two years before fattening. The rancher will sell this type of animal cheaply as compared with the mature store. This movement is all to the good, and anything which will help the early selling of stock from the ranches is to be encouraged.

It is noticeable that feeders in Mashonaland are now going far afield for store bullocks, and the purchases made

in the Melsetter and Chipinga districts during the current year have been of great benefit to farmers in those areas.

The export of beef this year has been handicapped by veterinary restrictions, and for part of the year it was only possible to export cattle from a restricted area in Western Matabeleland. As a result of these restrictions, and so as to keep up the volume of export, it was unfortunately necessary to relax somewhat the standard of cattle exported. Concessions were made for age, and the export of grass-fed chillers was permitted up to the end of September. Judging by reports which have been received from the United Kingdom, the lowering of the standard of the beef exported was unfavourably commented on, and prices indicated that the export of grass-fed and stall-fed cattle in the same shipment depressed the value of the stall-fed cattle.

In future, the standard of the grades should be maintained as strictly as possible, and the age limit should not be relaxed. Under local conditions the age factor is one of great importance. If an age limit of five years is set for export, in an ordinary year farmers are practically forced to top off their bullocks with supplementary feeding in order to reach the required quality within the age limit. In other words, in time practically only "stall-fed" bullocks will be exported, which is the ideal to be aimed at.

With growing experience feeders have become clever in feeding bullocks so as just to reach the grade set for export. This tendency became very noticeable towards the end of the present year. In the coming year, therefore, I would recommend that two grades for chilled beef for export be set, with a price difference between the two of them. A higher price for 100 lbs. dressed weight should be paid for young, well-topped, light bullocks, and a lower price for the old, comparatively mature, heavy animal now becoming popular. At present the same stabilised price is paid for both classes, and the heavier animal is the more profitable to the producer. If a price difference per 100 lbs. is made between the two grades, not only will the feeding of lighter bullocks be encouraged, but there will be the tendency to fatten a bullock more fully before selling it.

2. **Boneless Beef.**—A remarkable development in the export trade this year has been a rise in the price of boneless beef as compared with chilled beef. According to figures quoted in the *Meat Trades Journal*, for the first eleven months of 1935 the value of chilled beef showed a drop of 8d. per cwt., whereas that of boneless beef showed a rise of 2s. 6d. per cwt. As a result of this rise and an increase in the price of hides, the Rhodesian Export and Cold Storage Company was unable to work its plant to capacity, which greatly decreased the overhead charges per pound of beef handled. The price paid by the Company for cattle for boneless beef varied around 10s. per 100 lbs. dressed weight, but towards the end of the year it rose to as high as 14s. per 100 lbs. Boneless beef, on the basis of the present prices, is an excellent outlet for "scrub" cattle, and it is a pity that the demand for this article is not more general in the United Kingdom and less speculative.

3. **Extract of Beef.**—Some 26,000 head of cattle were put through Liebig's works at Mazunga this year for the manufacture of extract of beef, canned beef, etc. The prices paid for cattle varied from 2s. 6d. to 3s. 6d. per 100 lbs. live weight. During the latter part of the year the Company was handicapped by the lack of water, but its purchases have been of great use in relieving the southern end of the Colony of a large number of inferior cattle. There has been a general demand for the erection of a second extract factory in the Midlands, and it would be to the benefit of the cattle industry of the Colony if such a factory could be operated in the Midlands on an economic basis. It is doubtful, however, if sufficient cattle would be forthcoming at present prices to enable the factory to work on an economic plane for any length of time.

4. **Quotas.**—The export of beef from this Colony to the United Kingdom during 1935 was controlled by quotas laid down by that Government. The quota was 96,000 cwts. of all types of beef during the first half of the year, and 91,000 cwts. during the latter half, giving a total of 187,000 cwts. for the twelve months. Owing to the break in export, caused by an outbreak of foot and mouth disease, only 47,000 cwts.

of beef arrived in the United Kingdom from Southern Rhodesia during the period ended June 30th. During the latter part of the year, however, full use was made of the quota allotted.

5. **Subsides.**—The export of beef from the Colony was subsidised throughout the year. Subsidies were paid on the following basis:—

(a) $1\frac{1}{2}$d. per lb. on first-grade chilled beef throughout the year, with a basic return guaranteed to the Company of $3\frac{1}{2}$d. per lb.

(b) 1d. per lb. on second-grade chilled beef from the 1st April to the 30th September, inclusive, with a basic return to the Company of 3d. per lb.

A bounty of $\frac{1}{4}$d. per lb. was paid throughout the year on frozen beef and edible offals exported. A bounty of $\frac{1}{8}$d. per lb. on the estimated dressed weight was similarly paid on cattle utilised for extract of beef or exported as boneless beef.

The effect of these bounties was to maintain the internal price of cattle and make the export trade possible. These funds, in effect, kept the cattle industry alive.

These bounties have, however, had little effect in encouraging farmers to improve the quality of their cattle. The quality of the bulk of the cattle has not improved in the last year. It is interesting, if not practical, to speculate on what the position of the cattle industry would have been at this date if the £100,000 spent this year in bountifying the export of beef had been invested instead in the purchase of good bulls, fencing and more boreholes.

6. **Johannesburg Market.**—Export to the Johannesburg market, on the basis of a limited monthly quota, has been possible since September last. Owing to veterinary restrictions, the number of cattle available for export has been small. Most of these cattle have been of poor quality. Prices in Johannesburg were not considered particularly encouraging, considering the shortage of fat cattle on the local market, and this trade practically petered out temporarily by November last.

From 1st September to 30th November, inclusive, an export tax of 10 per cent. on the net value realised in Johannesburg of these cattle was levied by the Government. The purpose of this tax was to discourage the export of chiller cattle to Johannesburg and to collect revenue. In certain quarters this tax was considered to be a hardship on the export of inferior types of cattle to Johannesburg, and from 1st December it was reduced to 5 per cent. The reduction has not, however, affected the situation so far.

PURE-BRED CATTLE.

Breeders of pure-bred cattle have, on the whole, done distinctly better than in 1934. The Livestock Improvement Scheme has practically cleared up the country of good young bulls of service age. There has been a shortage of dairy and dual purpose bulls, and it has been necessary to import bulls of these breeds from the Union, fifteen being imported to date under the scheme. The demand for Shorthord bulls has, on the whole, been disappointing. It is felt, however, that this lack of demand is temporary, and that the breed will come back to its own once the cattle industry is on a better footing, as the Shorthorn under many conditions in the Colony provides the finest foundation for a beef steer. A number of breeders have changed over from Friesland to the Red Poll. Farmers are prone to change breeds on the least provocation, and it may be doubted if some of the dairymen who have disposed of their Friesland bulls really understand or need a dual purpose breed.

It is encouraging to note that the demand for records in the case of dairy bulls is becoming more insistent. It is becoming very difficult to sell an unrecorded dairy bull to any of the better dairy farmers in the Colony.

GENERAL.

Cattle farmers generally are pessimistic as to the immediate future of the cattle industry. There is faith, however, in the long-term prospects of the industry. Part of this optimism is based on an expectation that the run of low prices will induce the larger cattle ranching companies to liquidate their cattle and go out of business, leaving the

local market in a sounder position once the surplus has disappeared, and partly on a feeling that some form of control of the local market will be accepted before long. Both issues are controversial, but any disappearance of the ranching companies would handicap the export trade very considerably at the present stage. Not less than 75 per cent. of the chillers exported to-day are drawn from the ranching companies, and it is difficult to see where any uniform large body of similar cattle could be drawn from the small farmer producers for a long time to come. The areas at present operated by the ranching companies are suitable only for ranching on an extensive scale. It is to be hoped, therefore, that if the larger companies go out of business, encouragement will be given for the formation of smaller and more economic ranching units.

It is encouraging to note the increased interest in permanent pastures which has taken place recently. Much of this interest has been due to the pioneer efforts of the African Explosives and Industries, Limited, who, while indirectly encouraging the use of their fertilisers, have helped to spread the use of these pastures.

Of particular interest is Rhodes Grass. It is calculated that some 400 acres of this grass have been sown in the Salisbury district during the present crop season. A considerable though much smaller area has been put down to Swamp Couch, Paspalum and Kikuyu. In some cases the results are very encouraging. Permanent pastures in a small way have also made progress on the eastern border. Six experimental plots were laid down in Melsetter in co-operation with this Division. It may not be long before farmers realise that an area of properly cared-for permanent pasture is essential on a mixed stock farm in Mashonaland.

The secret of success with Paspalum dilatatum, Rhodes Grass and other improved pastures, but particularly with Rhodes Grass, seems to be that they must be adequately fertilised and not continuously over-grazed. In this respect rotational grazing is important, while an occasional cultivation seems to assist Rhodes Grass to maintain itself over a period of years.

SHEEP INDUSTRY.

General.—There has been a definite improvement in the sheep industry during the past year. A good deal of this improvement in the health of the sheep is due to Mr. R. H. Fitt, who was recently appointed Animal Husbandry Officer. This officer has concentrated on the control of internal parasites, and has visited the majority of sheep farmers in this Colony at least once during the past year. Until the health of the sheep is improved, it is not much good to look for an improvement in the industry or good results from the use of better rams.

Reports indicate that there has generally speaking been a marked improvement during 1935 in the health of the flocks in the western area of Matabeleland and on the Eastern Border. The Animal Husbandry Officer reports that he has noted a practical disappearance of hook-worm in the case of all *post-mortems* carried out on the Eastern Border at the end of this year, which is very encouraging. Reports from the Midlands are not so good—chiefly, it is considered, on account of lack of keenness on the part of the farmers as a result of a number of years' disappointment in sheep farming.

Sheep, if properly managed, form a very profitable sideline on the average farm. Farmers, however, have still to realise that it pays better to sell the young hamel than the old sheep. A sheep makes approximately 80 per cent. of its growth in the first year and, if kept longer than that, the decrease in quality does not make up for the increase in weight. It is not generally accepted either that the common practice of leaving the rams with the ewes throughout the year, in the expectation of raising two crops of lambs, is a bad one. The practice generally results in the stunting of the lambs and in an increase in parasitic infection due to the over-working of the ewes.

Wool prices of the clips of this Colony for this year are not yet known. It is anticipated, however, that prices will show an improvement over last year.

EXPERIMENTAL RESULTS.

(a) **Haemoglobin Counts.**—Hæmoglobin counts have been made in 24 flocks on the Eastern Border. In those flocks where the management in regard to parasitic control is con-

sidered "very good," the percentage of Hæmoglobin counts (Tallyquist) was from 80 to 90. In flocks where the management is described as "good," the count was 70, and in those where it is described as "poor," it varied from 30 to 50.

These results show conclusively, as far as the Eastern Border is concerned, that proper parasitic management is a most important factor in maintaining the health of sheep.

(b) **Romney Marsh Crosses.**—An interesting experiment is in progress on the Eastern Border, and 17 Romney Marsh rams have been introduced under the ægis of this Department into that area during the last two years. One hundred and seventy-six cross-bred lambs were born during the months of April to July last. Up to the present these lambs are showing very satisfactory promise and are ahead of the ordinary Merino lambs in the district. The weights achieved this year are a little disappointing, but this is due to the poor grazing from August to November, due to late spring rains and excessive locust invasions.

The figures in four flocks where weight records have been taken are of interest and are given below:—

Farm	Romney Marsh x Merino Age Days	Wt. Lbs.	Romney Marsh x Bastard Age Days	Wt. Lbs.	Merino Age Days	Wt. Lbs.
Rocklands—						
Early lambs ...	182	53	182	61	—	—
Late lambs ...	81	32	93	57	—	—
Sawerombi	217	60.7	—	—	224	51.2
Lemon Kop—						
Early lambs ...	170	53.8*	—	—	210	46.3*
	—	45.7‡	—	—	—	41.6‡
Late lambs ...	70	46.6*	—	—	—	—
	—	37.0‡	—	—	—	—
					Bastard Type	
Cecilton	—	—	150	65.0	240	59.0
	—	—	120	56.0	—	—

* = Males. ‡ = Females.

It is hoped, by using these Romney Marsh rams and by feeding the lambs a certain amount of supplementary feed on grass when still with the ewes, to turn out a first-class

mutton lamb for sale on the local market. There is a keen demand for this type of lamb, and steps are being taken to market, if possible, a selected lot of lambs of this type in Salisbury about Easter during the coming year, both as an advertisement of the Melsetter district and to test the economic possibilities of cross-breeding in the area.

PIG INDUSTRY.

General.—The year 1935 has been an improvement over the previous year, as far as the pig industry is concerned. Prices for baconers were maintained generally on a more uniform level at from 3½d. to 4d. per lb. live weight, and the unmarketable surplus of pigs which occurred in the latter part of 1934 did not occur again this year.

The feeling of insecurity in regard to the future of this industry still remains, and a general feeling exists that it will be necessary to grade pigs on the local market in order to secure any definite improvement. In these respects the position has not altered since 1934.

Three new bacon factories have been opened during the course of the year. This increase of factories is of doubtful advantage to the industry, which is already over-supplied with factories for the number of pigs available.

Frozen Porkers.—One experimental consignment of frozen porkers was sold in the United Kingdom in February last, and a further consignment is in transit at the time of writing. The porkers in the February consignment sold at from 4.61d. to 5.88d. per lb. in England. The average price per lb. was 4.9d., in comparison with the price of approximately 5¾d. which was ruling for New Zealand pork at the time of sale.

The prices obtained were not considered altogether satisfactory and, while the reports at Smithfield were very favourable, comments were received later from consumers indicating that in some cases at least the pigs had not eaten well. The Department was therefore left in doubt as to the interpretation to be put on the results of this experiment, and in the present consignment precautions have been taken to secure a fuller report on the pigs sold.

The present consignment includes four lots of pigs fed out at the Rhodes Matopo Estate on definite rations, so as to show the effect of feeds in common use in this Colony on the palatability and firmness of the porkers. To secure a full report on these points, the co-operation of the School of Agriculture at Cambridge has been sought.

It is intended to make further experimental consignments during 1936 and to include some frozen bacon in these consignments. The object of these shipments is to put this Department in a position to make definite recommendations as to the economic possibilities of the trade as soon as possible.

Breeding Pigs.—The quality of pigs continues on the whole to improve. A development, however, which is causing concern is a shortage of Large Black sows of good type. The Large Black sow is the foundation of the standard cross in use—that is, the Large White boar on the Large Black sow. As a result of the crossing, however, the supply of Large Black sows is running out, and breeders are commencing to use cross-bred Large Black x Large White sows in their breeding herds. This cross with a Large White boar has not been as satisfactory as the first cross, Large White x Large Black.

There would appear to be a very good opening in the near future for breeders producing a good type of Large Black sow.

CO-OPERATIVE EXPERIMENTS.

A number of co-operative experiments were undertaken during the course of this year. These experiments were carried out either at the Rhodes Matopo Estate or on selected farms.

In the case of the experiments on farms, the work was carried out in co-operation with the milk recorders, who supervised the records and followed the work closely at the time of their routine visits.

Experiments with Molasses Silage.—Doubt has been expressed as to whether molasses silage from a legume crop could be made successfully under the conditions of high

temperature which normally exist in this Colony during the months of February and March when the silage is made. This Department was consequently asked by the Rusape Farmers' Association to undertake some co-operative trials with farmers in different parts of the Colony.

Four experiments were carried out. In each case the molasses silage made was used in some ration to supply information required by the particular farmer or institution concerned. The experiments were carried out in co-operation with:—

(1) *The Rhodes Matopo Estate* (Bullocks)—
Silage from cowpeas chaffed before ensiling.

(2) *Mr. L. T. Tracey, Chikari* (Dairy Cows)—
Silage from dolichos beans not chaffed.

(3) *Mr. R. Fischer, Headlands* (Dairy Cows)—
Silage from cowpeas chaffed before ensiling.

(4) *Mr. H. J. Orford, Rusape* (Dairy Cows)—
Silage from cowpeas chaffed before ensiling.

No special precautions were taken in the manufacture of the silage, except to make it in the cool of the morning as far as possible, pack the material thoroughly and fill the silo as quickly as possible. Molasses was added at the rate of approximately two gallons of molasses suitably diluted per ton of green material.

In one case (Rusape), where there was an unavoidable delay in the packing of the silo, the silage was unsatisfactory. The feeding experiment here was therefore not completed.

In the other three cases excellent silage was made and consumed without difficulty. The results were considered so satisfactory from a feeding standpoint that it is likely that some of the work will be repeated in the coming year without the molasses.

Chemical analyses furnished by the Chief Chemist do not show an appreciable loss of protein in the manufacture of silage:—

Percentage Crude Protein calculated to 100 per cent. Dry Matter.

Source	Chaffed Material Time of Ensiling	Completed Molasses Silage
Rusape	17.1	17.5
Headlands	13.1	13.9
Chakari	12.2	13.3

Feeding Results: (1) *Steers.* — Two groups of seven uniform Angus x African steers were fed out at the Rhodes Matopo Estate.

Group 1 received 8 lbs. of cowpea hay, 16.5 lbs. of veld hay and 10 lbs. maize meal per day.

Group 2 received 25 lbs. molasses cowpea silage, 17.1 lbs. veld hay and 10 lbs. maize meal per day.

Group 1 gained 290 lbs. per steer in 98 days.

Group 2 gained 276 lbs. per steer in the same time.

No difference in the finish of the steers was apparent. Both lots did well, and 8 lbs. of cowpea hay is apparently equal in fattening value to 25 lbs. of molasses cowpea silage under these conditions.

(2) *Dairy Cows.*—Two groups of comparable dairy cows at Headlands and Chakari were fed in the usual double reversal method of three-week periods with a preliminary period of one week on rations containing molasses silage or the respective legume hay.

(a) At Headlands two groups of ten cows each were used in the experiment. Group 1, which received 30 lbs. of molasses cowpea silage per day, plus concentrates, gave 15,496 lbs. of milk in the three periods of 9 weeks in which they were on molasses silage. Group 2, which received 10 lbs. of cowpea hay, plus 25 lbs. of mjordas per day instead of cowpea silage, plus the same amount of concentrates, gave 15,784 lbs. of milk in the same length of time.

The concentrate ration in each case was the same and consisted of maize meal and sunflower-head meal.

In this trial, from the feeding standpoint, 30 lbs. of molasses silage proved equal to 10 lbs. of cowpea hay, plus 25 lbs. of mjordas.

(b) In the experiment at Chikari, 30 lbs. of molasses dolichos silage was fed in comparison with 15 lbs. of maize and dolichos bean silage, plus 5 lbs. of bean hay. Two groups of six cows each were used, and the cows received the same concentrate ration, which consisted of maize meal 4 lbs., plus sunflower-head meal $1\frac{1}{2}$ lbs. per head per day. The six cows while on dolichos silage produced 4,969 lbs. of milk in three periods totalling nine weeks. The six cows while on maize and bean silage produced 5,077 lbs. of milk in the same length of time.

In this experiment 30 lbs. of molasses dolichos bean silage proved equal to 15 lbs. of maize and bean silage and 5 lbs. of dolichos bean hay.

THE FEEDING OF SALT AND IRON LICKS TO LIVE STOCK.

1. **Dairy Cattle:** *Trial carried out by Mr. R. le S. Fischer, Headlands.*—Three groups of five comparable grade Friesland cows each were fed the following licks for a complete lactation period:—

Group 1: A lick consisting of 100 lbs. sterilised bone meal, 100 lbs. salt.

Group 2: A lick consisting of 125 lbs. sterilised bone meal, 100 lbs. salt, 25 lbs. red oxide of iron, 1 lb. copper sulphate.

Group 3: A lick consisting of 100 lbs. sterilised bone meal, 100 lbs. salt, 2 lbs. sulphate of iron, $\frac{1}{2}$ lb. copper sulphate.

The cows otherwise were kept under similar conditions and fed the same concentrate ration according to production.

A measured 4 ozs. per head of each of these licks was given on the concentrate mixture in the mangers at feeding time.

The milk production of the three groups was as follows:—

	Yield, 1935	Yield Same Cows Previous Lactation
Group 1—		
Control	24,915 lbs.	22,549 lbs.
Group 2—		
Oxide of iron	25,964 lbs.	27,816 lbs.
Group 3—		
Ferrous sulphate ...	28,224 lbs.	29,935 lbs.

One cow in the control group developed an abscess of the udder and was dried off early.

The ferrous sulphate group out-yielded the other two groups, but the difference is not considered significant. There was no noticeable difference in the condition of the three groups of cows.

One cow in each group has re-calved to date; the others appear to be in calf.

2. **Pigs:** (a) *A Trial carried out in co-operation with Mr. W. Sole, "Bauhinia," Glendale.*—Two groups of six pigs each of Large White-Large Black cross were used in this trial. The pigs were 63 days of age at the commencement of the trial and were fed the rations given for 73 days. One pig then reached market weight of 171 lbs. and was sold. All the pigs were then weighed and the experiment terminated.

The pigs received a ration of maize and separated milk, with some cut green grass as green feed.

Group 1 received 1 lb. of salt, plus 1 lb. of bone meal for every 100 lbs. of grain fed.

Group 2 received 1 lb. of bone meal, plus 1 lb. of the following salt and iron oxide mixture for every 100 lbs. of feed:—

Salt	100 lbs.
Iron oxide	25 lbs.
Copper sulphate	1 lb.

Group 1 (Control): Six pigs gained 390 lbs. during the period of the experiment.

Group 2 (Iron Oxide): Six pigs gained 389 lbs. during the period of the experiment.

No difference was noted in the rate of gain of the pigs, or in the colour and firmness of the carcases after slaughter, as a result of the use of iron oxide. Mr. Sole says, however: "As far as I can judge, the experiment has been negative. I am of the opinion the red oxide ones looked better than the others, but the scale did not bear this out."

(b) *Rhodes Matopo Estate.*—Two similar groups (ten pigs per group) of Large White x Large Black and Tamworth x Large White pigs were fed on the following rations:—

Group 1: 90 lbs. maize meal, 10 lbs. meat meal, 2 lbs. bone meal, 1 lb. salt.

Group 2: 90 lbs. maize meal, 10 lbs. meat meal, 2 lbs. bone meal, 1 lb. salt and iron mixture (100 lbs. salt, 2 lbs. $FeSo_4$, $\frac{1}{2}$ lb. $CuSo_4$).

The concentrates were fed twice daily in the form of a thick slop. The daily concentrates for the two groups were kept exactly the same. Daily the pigs received a small quantity of green feed. The maize and green feed were grown at the institution.

The following table gives particulars of weights, etc., of the two groups:—

	Group 1	Group 2
Average initial weight (20.12.34)	74	73
Average final weight	179	173
Average final age	165	165
Average gain in weight	105	100
Average number of days fed	63	63
Average daily gain in weight	1.67	1.59
Average daily consumption of concentrates	4.9	4.9
Lb. concentrates per 100 lbs. gain in weight	292	308

From the above it appears that the feeding of the iron supplement had no beneficial effect whatsoever on the growth of the pigs.

3. **Sheep:*** *Rhodes Matopo Estate.*—Forty nine-month-old Merino lambs were divided into four similar groups on the 29th May, 1933. The four groups were grazed together day and night, but every morning the different groups were sorted out and fed individually the following mineral supplements:—

Group 1 (Control): No supplement.

Group 2: 2.5 gms. Di-Ca-Phosphate each per day.

Group 3: 3.5 gms. NaCl.

Group 4: 1 gm. $FeSo_4$, $7H_2O$.

Throughout the period the sheep were weighed at monthly intervals and regularly dosed for internal parasites. The lambs were not very strong and vigorous, as they were suffering from spear grass and steek grass (*Aristida congesta*).

On each weighing day the Hæmoglobin content of the blood was also determined, using the Tallyquist.

The following table gives particulars of the average weights of the sheep and the Hæmoglobin content of their blood:—

Average Weights of Four Groups.

	1 Control	2 2½ Gms. Di-Ca-Ph.	3 3½ Gms. NaCl.	4 1 Gm. $FeSo_4$
May 29	56	56	55	55
June 26	54	51	53	51
July 24	57 (1)	49 (3)	53 (1)	52
August 21	63	63 (2)	62 (1)	58
September 18 ...	68 (3)	59	62 (1)	57
November 12 ...	67	60	59	55
December 13	72	66	67	62
January 10	77	68	71	63

Numbers in brackets indicate number of deaths during month.

*This experiment was completed in 1934 but not previously reported.

Average Hæmoglobin Numbers of Four Groups.

	1 Control	2 2½ Gms. Di-Ca-Ph.	3 3½ Gms. NaCl.	4 1 Gm. $FeSo_4$
May 29	82	81	83	82
June 26	76	73	75	78
July 24	82	84	79	87
August 21	81	86	88	89
September 18 ...	85	86	87	90
November 12 ...	82	84	83	87
December 13	83	86	85	87
January 10	83	76	81	83

The average weights of the four groups show very little differences. Although the iron-fed group showed the lowest average weights, it should be pointed out that this was no doubt due to the fact that the weaker and lighter lambs died in the other groups.

It is of interest to note here that in the Control group four died, Phosphorus group five, Salt group three, and Iron group none.

The table also shows very little difference in the Hæmoglobin content of the blood of groups 1, 2 and 3. It appears, however, that the iron-fed group was consistently somewhat higher in this respect.

Conclusions: Mr. C. A. Murray, who carried out the experiment, says no definite conclusions can be drawn.

He says, however, that there seem to be indications that, under the conditions of this experiment:—

(1) The sheep derived no benefit from the feeding of phosphorus, sodium or chlorine.

(2) The feeding of sulphate of iron may have had a beneficial effect in decreasing the number of deaths in the iron group, though this benefit is not reflected in the live weights. The effect in this case may possibly be due to the medicinal or tonic properties of the iron mixture.

Summary of Mineral Feeding Experiments.—These mineral feeding experiments are inconclusive, but do not apparently show any benefit from using iron oxide in addition to salt under ordinary farm conditions.

These experiments are being repeated, both with sheep and cattle, in different parts of the country and for longer periods, to obtain further data.

LIVE STOCK IMPROVEMENT SCHEME.

The scheme has met with very general approval from the farming community. Two hundred and ninety-four applications for grants were received up to the 31st December, 1935. The number of applications would probably have been considerably larger, except that it was necessary to advise farmers in September last that funds available had been temporarily exhausted. A number of persons consequently did not put in applications who might otherwise have done so.

The allocation of the grants to date has been as follows:—

	No. of Applications	No. Approved	No. not Approved, or Withdrawn for Various Reasons
Cattle	218	109	60
Sheep	31	12	10
Pigs	25	9	11
Total	274	120	81

Sixty-three have still to be investigated.

The chief reasons for the non-approval of grants were: (a) Inefficient live stock management, (b) Neglect of the cattle on account of attention to some other enterprise, such as tobacco or maize-growing.

The scheme has undoubtedly done a great deal of good.

Annual Report of the Acting Chief Animal Husbandry Officer

FOR THE YEAR ENDED DECEMBER 31st, 1936.

By C. A. MURRAY, Act. Chief Animal Husbandry Officer.

CATTLE INDUSTRY.

1936 was certainly the most prosperous year for the cattle industry since 1931. Losses from poverty were practically nil and prices for all classes of slaughter stock good.

Heavy losses during the previous year from drought over-stocking and neglect by many to provide winter reserves, good late rains and hence good winter grazing during the present year, the export of 82,717 head of cattle during the past year, the re-opening of the Johannesburg market and an increased local consumption are all responsible for the satisfactory state of the cattle industry at the moment.

Unless extensive outbreaks of disease occur and/or the export of cattle discontinues the next three or four years are indeed bright for the cattle farmer. It is hoped that boom prices will not be experienced as these are never of a permanent nature. A reasonable profit to the careful farmer is all that is desired.

It was unfortunately necessary for veterinary reasons to close up a large area for a long period of time. Satisfactory arrangements were made, with the assistance of a Government subsidy, for the disposal of all saleable cattle in that area at very reasonable prices to the producer.

Export Trade.—During the year 14,173 chillers were exported of which 12,074 were supplied by Matabeleland and 2,099 by Mashonaland farmers.

1. *Chilled Beef.*—Prices realised during the year for chilled beef exports showed a slight increase on the previous year. Especially was there a very distinct hardening in prices during the period August to December. On most shipments

during this period the Government received a refund as average prices realised were in excess of the guaranteed basic price.

Although there was a slight improvement in prices realised for our meat heavy bounties were unfortunately still necessary.

It is hoped that the new Anglo-Argentine agreement which will not only maintain quotas but also impose an import duty of ¾d. per lb. on all foreign chilled beef imported into the United Kingdom will have the effect of raising prices on the United Kingdom markets. This preference granted to Empire countries and any increase in price which may result will assist our export trade very considerably.

The current agreement with the Rhodesian Export and Cold Storage Company, Limited, has on the whole operated satisfactorily and the Company is to be congratulated on the year's working. It was unfortunate that for veterinary reasons export had to be discontinued for a period of two months (8-3-36 to 30-4-36) and that later in the year it was, for the same reason, not possible to draw cattle from the Fort Victoria area. Not only was continuity of supplies broken but preparation charges increased and heavy losses sustained by the Government, farmers and the Company.

During the years 1934, 1935 and 1936, 4,000, 16,000 and 14,000 stall-fed chillers were exported. The decrease in number during the present year was mainly due to veterinary restrictions which not only resulted in shortage of store cattle but also caused uneasiness amongst feeders. On the whole, however, it is promising to note that although there was a decrease in the actual number of stall-fed chillers exported there was a distinct improvement in quality and, therefore, prices realised.

Although the prices paid to the farmer for the two grades of chillers were on the whole satisfactory it was felt that, as the better grade (Imperial) is the important one from the standpoint of the future, there should be a larger difference in price in favour of this grade to encourage its production. The necessary arrangements were, therefore, made for the revised scale of prices to take effect from April 1st, 1937,

when the current agreement with the Company expires. It is hoped that this further encouragement will result in the feeding of younger and better cattle by feeders.

There is already a welcome tendency for feeeders to purchase younger cattle and grow and winter them to mature at a much earlier age than is possible on the average ranch. This is in the right direction and it is encouraging to know that the research work carried out at the Rhodes Matopo Estate has given farmers a very definite lead in this direction.

As stated above by far the greater number of stall-fed chillers were supplied by Matabeleland farmers. Mashonaland farmers were not prepared to pay breeders the price asked for store cattle. The result was that ranchers and other breeders commenced feeding their own steers. This system is unfortunately economically unsound as the store animal should be brought to the maize growing areas for fattening and the manure left where required.

Feeders should be satisfied when receiving a price in excess of export value for maize and satisfactory prices for roughages such as veldhay, maize stover, beanhay and ensilage through the steers and also all the manure which is generally valued at approximately 10s. per steer. To demand a substantial cash profit in addition is unreasonable and unheard of in other exporting countries.

2. *Frozen Beef.*—The Company again managed to obtain a contract for the supply of frozen beef and 17,275 head were exported at a reasonable price to the producer. This outlet for inferior quality steers had a most beneficial effect on the local market. As the production of this class of animal is not to be encouraged an increase in price is not desirable and an average price in the vicinity of 16s. to 17s. per 100lbs. dead weight appears to be satisfactory. A total of 836 carcases of frozen vealers were also exported.

3. *Boneless Beef.*—A slight increase in price during the year for this class of beef was of considerable assistance although, with the improvement of the local market and as a result of veterinary restrictions the Company could not get

sufficient of this class of animal to run the works to capacity. Boners are also essentially scrub cattle, the production of which is not to be encouraged. A total of 11,536 boners were slaughtered and exported.

It should be pointed out here that until such time as the Company can get sufficient chillers it is essential that boners and/or freezers be exported so as to run the plant to capacity. The importance of running the export works to capacity is often not appreciated but preparation charges per pound of beef are practically doubled when the amount handled is halved.

4. *Extract of Beef.*—A total of 37,237 head of cattle were slaughtered at Liebigs Works at West Nicholson for manufacture into extract of beef, canned beef, meat powder, etc. The Company is also to be congratulated on the year's working.

5. *Quotas.*—During the year our total meat exports to the United Kingdom were limited to the same quantity as during the previous two years, *viz.*, 187,000 cwts. Figures are unfortunately not yet available but exports were, it is considered, well below this figure.

6. *Subsidies.*—During the year it was unfortunately still necessary to subsidise the export of all classes of meat.

(*a*) On chilled beef a bounty of $1\frac{1}{4}$d. per lb. was paid with basic return guaranteed to the Company of $3\frac{1}{4}$d. per lb. and any realisation in excess of this figure to be refunded to the Government. It is anticipated that a refund of approximately £8,000 will accrue to the Government.

(*b*) A bounty of $\frac{1}{4}$d. per lb. on frozen beef, edible offals and casing exported.

(*c*) A bounty of $\frac{1}{4}$d. per lb. dressed weight of cattle from which boneless beef, boneless veal or extract of beef is derived.

7. *Johannesburg Market.*—Due to Veterinary restrictions no Southern Rhodesian cattle were allowed access to Johannesburg during the period, April to October. During the year a total of 1,660 head were exported.

Towards the end of the year prices on the Johannesburg market were exceptionally good with the result that a large number of suitable chillers found their way there instead of overseas.

8. *Local Market.*—As pointed out previously prices on the local market reached very satisfactory levels during the year. This market is an exceedingly important one to the cattle farmer and every effort should be made not to allow it to collapse again. The cheapest and easiest way of assuring a stable local market is to keep surplus cattle off by export—subsidised when necessary. This is certainly very much more desirable and sound than control which has been suggested from certain quarters.

In a sparsely populated country like Southern Rhodesia with difficult climatic conditions the control of cattle and meat markets—of a very perishable product—will be not only very difficult but also very expensive. Further, the expenses connected with it will be additional to bounties for export.

9. *Railage and Freight on Meat Exports.*—Under the March, 1935, Trade Agreement with the Union a railage rebate of .24d. per lb. on chilled beef was obtained. Frozen and boned beef was unfortunately not included and it seems advisable to make representations in this direction. A similar rebate on frozen and boned beef would enable poor quality cattle to be exported at times without the aid of a bounty.

Ocean freight still amounts to .62d. per lb. and any very small reduction will be of considerable benefit to the country. The newly formed Shipping Board might be of assistance in this direction.

Pure-bred Cattle.—Breeders of pure-bred cattle have done much better than during the previous year. As a result of more optimistic outlook in the cattle industry and the assistance of the Livestock Improvement Scheme local breeders have disposed of practically all available bulls at satisfactory prices. There was a shortage of bulls of different breeds and types especially dairy and dual purpose breeds as a result of which a total of 24, of which 18 were Frieslands, were imported from the Union under the Livestock Improvement Scheme.

During the year there was an improved demand for Shorthorn and Hereford and Sussex bulls. Amongst the dairy breeds there was very little demand for the Ayrshire.

Breeders remain prone to change breeds although in most cases more improvement can be effected by improved methods of management and feeding. The saying that "half an animal's breeding goes down its throat" is not sufficiently appreciated by the majority of stock farmers in the Colony.

On the whole the demand for pure-bred bulls has increased very considerably during the year.

In the case of dairy bulls animals without good records are difficult to sell and better value for money will probably be obtained for years to come by importing selected animals from the Union.

General.—Generally speaking the cattle industry is prosperous at the moment. The future seems assured for a number of years provided nothing unforseen happens.

The closing of several large ranches has been a rather bad advertisement for the Colony. Ranching on not too large a scale is to be encouraged as very large areas of cattle country is only suitable for this type of farming.

Although mismanagement is still to be found on many farms there is a tendency to improve in many quarters and the advice of this Division is proving of great value.

SHEEP INDUSTRY.

On the whole the sheep farmers have experienced a satisfactory year. Prices for good quality slaughter sheep were very satisfactory.

Wherever farmers are following the advice of this Division on the management of their flocks and the control of internal parasites sheep are doing well and are proving a very profitable sideline on the average farm.

The Sheep Officer continued doing good work and if farmers continue on the right lines it should not be long before the importation of mutton sheep from neighbouring territories to the annual value of £15,000 to £20,000 will not be necessary.

During the past few years deaths have been decreasing steadily no doubt as a result of better management and improved parasite control.

In the drier areas of the country and parts where grass seeds are troublesome, the Blackhead Persian is doing very well. In the Eastern districts the use of the Romney Marsh on the Merino has so far proved very successful. It has porduced a better mutton sheep and an animal better adapted to the high rainfall conditions.

Last year's prices for wool were very satisfactory and showed an increase over the previous years. The average yield of wool per sheep showed an increase. This is very encouraging.

There was a very heavy demand for good male and female breeding stock. As local breeders could not supply sufficient the Department's officer made these purchases for the farmers in the Union. The sheep that were brought up were of very good type and conformation and should in time effect considerable improvement in the different flocks. Several small stud flocks were established which should in time supply sufficient flock rams for use in the Colony. A total of 76 pure-bred rams, 137 stud ewes and 432 flock ewes were brought up.

PIG INDUSTRY.

The pig industry experienced a rather unsatisfactory year. In Mashonaland due to too extensive breeding and in the Eastern districts, Victoria and Matabeleland due to Veterinary restrictions, there was once more an oversupply of pigs followed by the usual drop in prices.

Generally speaking, the quality of pigs continues to improve but very few farmers pay attention to the finer points in pig production.

Unfortunately a number of farmers go in for pigs on too extensive a scale. Pigs should be considered a most useful sideline on a mixed farm where not more than 3 or 4 sows are kept and the progeny well done. Unfortunately a number of farmers run up to 12 and more sows with the result that over-production follows.

There are also a number of pig farmers of the "in and out" type who usually commence breeding on a large scale when prices are good and usually have pigs for sale when prices are going down. They then throw their pigs on the market and get out of the business. This type of producer does more harm than good to the industry and never makes any money out of it. On the other hand the steady farmer who keeps a few sows year in and year out always does reasonably well.

Especially in Matabeleland white pigs suffer badly from sun-scald unless suitable quarters and extensive shade are provided. In other parts where sun-scald cannot be prevented the Tamworth (boar) x Large Black (sow) cross is recommended. It produces the best quality *black* bacon and pork pig. In other areas the Large White (boar) x Large Black cross is recommended for both baconers and porkers.

Internal parasites continue to cause heavy losses where pigs, especially sows with litters and weaners, are run in small camps. The use of farrowing and fattening pens with concrete floors is the only effective preventive.

No new bacon factories were opened during the year and one was closed down.

Two factories, one in Salisbury and one in Bulawayo are quite sufficient to handle all the supplies economically.

There has been a lot of dissatisfaction in regard to the grading of pigs by factories and butchers and in many cases it has certainly been justified.

Legislation dealing with the pig industry will be submitted to Parliament during the coming session.

Baconers.—The effect of the drop in prices was naturally mostly felt by the producers of bacon pigs. At the same time the factories complained that more and more soft pigs were being produced and feeds recommended by this Division such as wheat by-products, meatmeal, bloodmeal and bonemeal were blamed. Due to the oversupply the factories had to "contract" supplies to deliver on definite dates with the result that baconers often had to be kept for up to 4 weeks before they could be delivered. During this period they had to be starved and fed on unbalanced watery rations to prevent them

from going overweight. Investigation has shown this to have been one of the major causes of softness. A further trouble is that pigs are demanded so lean that they are often unfinished and hence soft.

A co-operative experiment is at present in progress to determine the effects of various feeds on the firmness of bacon pigs.

During the year a small experimental consignment of frozen bacon carcases were exported to the United Kingdom. Reports received indicated that the Colony could, with improved methods, produce a very acceptable beconer for export. Nett prices amounted to under 3d. per lb. liveweight f.o.r. Bulawayo at which figure farmers cannot produce. Subsidised export until a first quality article is produced at a low price and until there is an increase in overseas prices will, therefore, be necessary.

Porkers.—The pork market remains glutted, and especially in Matabeleland, is largely supplied with inferior quality, scavenger native pigs.

The feeling that pork should be graded for local consumption is stronger than ever before.

A further experimental consignment of frozen porkers was exported during the year. These were fed in an experiment in co-operation with A. Millar of Estes Park, Salisbury. Different groups were fed at different levels of protein and feed intake to see the effect of those on the quality of the carcases. Detailed trade and technical reports were obtained on these and the results published in the January Agricultural Journal. It was considered that the Colony could produce very acceptable porkers for the United Kingdom markets. Prices realised compared favourably with New Zealand and Australian prices.

It is impossible to speculate on the future of this trade but present indications are that it will not be profitable in the near future without a subsidy. There are, however, indications that prices will harden during the next few years.

A reduction in railway rates and ocean freight will be of very considerable assistance and give the possibility of developing an export trade an entirely different complexion.

Breeding Pigs.—On the whole the quality of pigs produced continues to improve, especially in the case of the Large White breed. Several breeders are breeding young boars of this breed for sale.

There is still a shortage of good Large Black sows but several breeders have commenced breeding.

When purchasing breeding stock farmers should pay more attention to length, firmness of shoulders and plumpness of ham. In females motherly qualities should also be taken into consideration.

CO-OPERATIVE EXPERIMENTS.

A number of co-operative experiments were undertaken during the course of the year, the report on these will be deferred until the Chief Animal Husbandry Officer returns from leave.

LIVESTOCK IMPROVEMENT SCHEME.

As during the previous year the Scheme has been a great success and proved of very considerable assistance to the farming community.

Up to the 31st December, 1936, a total of 349 applications for grants were received as compared with 274 during the previous year and considerably more would have come in had it not been that farmers were advised early that funds were exhausted.

Below are given particulars of the number of applications received, approved and refused. Figures for the previous year are given in brackets.

	No. of Applications.	No. Approved.	No. not approved or withdrawn for various reasons.
Cattle	241 (218)	175 (109)	66 (60)
Sheep	90 (31)	71 (12)	19 (10)
Pigs	18 (25)	5 (9)	13 (11)
Total ...	349 (274)	251 (130)	98 (81)

Inefficient livestock management was the chief reason for the refusals.

It was encouraging to note the increased demand for beef bulls. This was no doubt due to the generally improved state of the cattle industry. Dual purpose bulls were also in demand and there was a considerable shortage of Friesland bulls with good milk and butterfat records. As a result of this a total of 18 outstandingly good bulls were purchased by the Chief Animal Husbandry Officer at the September Bloemfontein sales for different farmers under the Scheme.

The value of the Scheme can be gauged by the fact that more than half of the applicants would definitely not have been in a position to purchase bulls without assistance and a number of others would very likely have purchased cheaper inferior animals. In addition all the bulls purchased under the Scheme had to pass Government inspection which eliminated the purchase of weak animals of a type and breed not suited to the applicant's farm and conditions. This is one of the strong points of the Scheme.

In addition to the introduction of suitable fresh blood the Scheme has also been or enormous educative value. All the applicants' herds were inspected and where necessary advice given which was, in 90 per cent. of the cases, readily accepted and acted upon. Those turned down were also advised of the reasons for their applications being refused and in the majority of cases improved management resulted.

During the coming year it is anticipated that the demand will be very much greater than during the present year and it is suggested that new applicants or those who have received no assistance previously be given preference over those who have had grants during the previous two years. In the same way those who have had only one grant will receive preference over those who have already had two. This will allow the maximum number of approved farmers to benefit under the Scheme.

In conclusion let it be said once more that the £3,000 provided on the 1936/37 estimates have been well spent and effected improvement in the cattle industry of a permanent nature.

Staff.—During the year a Meat Grader was brougth out from Smithfield and took charge of the grading of all chilled beef at Bulawayo. There were no other staff changes except that Dr. Romyn was on leave from September 23rd to February 23rd. During the period Mr. C. A. Murray, Senior Animal Husbandry Officer in charge of the Rhodes Matopo Estate acted for him.

Southern Rhodesia Weather Bureau.

JUNE, 1937.

It is with great regret that we learn of the death of Mr. A. R. Morkel, one of the oldest private observers in our roster. Mr. Morkel begun returns from Ceres early in 1914 and consistent records have been received up to the date of his death.

Pressure.—Barometric pressure during the month was 0.7 to 1.0 millibars low over the whole country except in the extreme west where is was about normal.

Temperatures.—Day temperatures were fairly high everywhere but night temperatures were well below normal and although no phenomenally low temperatures were recorded, frost occurred very persistently.

Humidity and Rainfall.—Very little rain was recorded during the month and the moisture content of the air was very low.

Weather Features.—Temperatures were high at the beginning of the month, but fell on the 3rd with the arrival of a high from the south-west. The high did not completely cover the country until the 6th, and weather was cloudy in the north during the interval.

A southerly low caused a fall of pressure on the 7th and 8th, but a further rise occurred on the 9th, and by the 10th an intense high was centred over the Transvaal, moist SE winds producing overcast conditions in the south and east. Falling pressure and fair weather were reported on the 11th, and on the 12th a low was centred to the south-east of Lourenco Marques, with a trough extending into the Limpopo Valley.

Pressure rose on the 13th, and in spite of considerable fluctuations on the south coast, Southern Rhodesia pressures remained steady at a little below the normal value until the 24th. Weather was fine with warm days and cold nights. On the 25th a very deep low had developed over the south coast, and on the 26th the following high was approaching across the west coast. Cold air reached Southern Rhodesia on the 28th, and cloud developed in the south and east. Pressure remained high and temperatures low until the end of the month.

JUNE 1937.

Station.	Pressure Millibars, 8.30 a.m. Mean.	Normal.	Temperature in Stevenson Screen °F. Absolute. Max.	Absolute. Min.	Mean. Max.	Mean. Min.	Mean. ½ Max. Min.	Mean. Normal.	Mean. Dry Bulb.	Mean. Wet Bulb.	Rel. Hum. %	Dew Point F.	Cloud Amt. 0-10	Precipitation. Ins.	Precipitation. Normal	Precipitation. No. of Days	Altitude (Feet)
Angus Ranch... ...	...	...	87	41	75.9	46.3	61.1	61.6	56.0	49.9	65	44	...	0.00	0.21	...	...
Beitbridge...	970.1	...	94	35	80.6	41.6	61.1	...	54.8	46.4	51	37	1.2	0.00	0.02	...	1,500
Bindura...	895.9	...	83	34	74.9	45.0	59.9	...	56.4	49.3	60	43	1.9	0.00	0.06	...	3,700
Bulawayo	873.5	874.2	81	35	72.6	43.7	58.1	57.3	57.3	46.9	45	34	1.4	0.00	0.03	...	4,393
Chipinga	896.6	...	81	46	72.1	51.2	61.6	...	63.8	53.0	50	44	1.4	0.29	0.66	1	3,685
Enkeldoorn...	861.3	...	81	38	71.2	44.4	57.8	57.4	57.7	48.4	52	39	1.7	0.04	0.07	1	4,788
Fort Victoria	900.1	901.0	83	31	73.5	38.5	56.0	55.0	54.6	47.0	56	39	1.2	0.00	0.09	...	3,571
Gwaai Siding	909.0	...	86	25	79.9	35.5	57.7	...	47.2	41.1	57	33	1.2	0.00	0.00	..	3,278
Gwanda...	911.0	...	86	31	75.0	38.4	56.7	...	53.6	45.5	52	37	1.3	0.00	0.06	...	3,233
Gwelo	866.1	...	79	35	70.7	41.8	56.3	57.1	52.3	45.0	56	37	1.3	0.00	0.02	...	4,629
Hartley...	889.6	...	83	32	75.6	40.1	57.9	59.0	56.2	48.1	54	40	0.9	0.00	0.01	...	3,879
Inyanga...	840.1	...	77	32	69.4	40.5	54.9	...	59.3	47.9	42	36	1.2	0.00	0.12	...	5,503
Marandellas	841.0	...	76	39	68.5	45.1	56.8	...	55.9	47.1	51	38	1.7	0.00	0.09	...	5,453
Miami	882.6	...	81	40	73.5	46.4	60.0	...	60.6	53.0	60	47	1.0	0.00	0.12	...	4,090
Mount Darwin ...	911.8	...	85	31	76.7	43.0	59.8	..	60.1	53.0	63	48	1.8	0.00	0.04	...	3,179
Mount Nuza	804.4	...	68	40	57.9	44.0	51.0	...	50.5	42.6	53	33	...	0.90	2.48	4	6,668
Mtoko	881.3	...	81	45	72.6	50.0	61.3	...	60.2	52.9	62	47	0.9	0.00	0.06	...	4,141
New Year's Gift...	...	...	87	36	76.4	43.5	59.9	...	55.7	51.3	74	47	...	0.20	0.41	1	2,690
Nuanetsi	967.4	...	90	32	80.6	37.7	59.1	...	54.8	47.2	56	40	1.6	0.00	0.08	...	1,581
Plumtree	868.3	...	80	42	71.2	48.5	59.9	...	59.1	46.3	37	30	0.3	0.10	0.00	1	4,549
Que Que	885.9	...	83	38	76.0	42.9	59.5	...	57.1	48.0	50	39	0.8	0.00	0.01	...	3,999
Rusape	866.0	...	79	31	70.2	39.6	54.9	...	51.9	46.6	66	42	1.3	0.00	0.29	...	4,648
Salisbury	859.9	860.5	78	36	72.6	44.0	58.3	57.1	58.3	49.1	51	40	1.3	0.00	0.06	...	4,831
Shabani...	...	...	86	36	74.4	43.7	59.1	...	58.6	48.6	47	38	0.7	0.00	0.16	...	3,131
Sinoia	892.6	...	84	29	77.1	38.4	57.7	...	55.0	48.6	63	43	0.6	0.00	0.02	...	3,795
Sipolilo	889.1	...	81	34	74.0	45.1	59.5	...	60.8	52.9	58	46	1.9	0.00	0.04	...	3,876
Stapleford	845.5	...	75	23	63.8	34.6	49.2	...	53.1	48.3	71	44	2.7	0.54	1.21	3	5,304
Umtali...	897.2	897.9	82	39	74.3	46.4	60.4	59.9	59.6	52.1	61	46	1.8	0.00	0.26	...	3,672
Victoria Falls... ...	916.9	...	91	29	81.2	39.7	60.5	...	54.7	48.2	62	42	0.7	0.00	0.01	...	3,009
Wankie	932.2	...	91	41	83.1	48.9	66.0	...	56.2	47.8	52	39	0.3	0.00	0.00	...	2,567

Southern Rhodesia Veterinary Report.

MAY, 1937.

DISEASES.

No fresh outbreaks of schedule diseases.

TUBERCULIN TEST.

Twenty-six bulls and two cows were submitted to the tuberculin test with negative results.

MALLEIN TEST.

Eighty-seven horses were tested upon entry. No reaction.

IMPORTATIONS.

From the Union of South Africa: Horses, 87; bulls, 22; cows, 2; sheep, 1,787; goats, 21.

From the United Kingdom: Bulls, 3.

EXPORTATIONS.

To the Union of South Africa: Oxen, 319; Cows, 88.

EXPORTATIONS: MISCELLANEOUS.

To the United Kingdom in Cold Storage: Chilled beef quarters, 10,672; frozen boned beef quarters, 6,982; frozen beef quarters, 4,203; kidneys, 3,664lbs; tongues, 16,701lbs.; livers, 33,421lbs.; hearts, 10,008lbs.; tails, 3,518lbs.; skirts, 3,384lbs.; shanks, 19,654lbs.

Meat Products: From Liebigs Factory.—Corned beef, 83,208lbs.; meat extract, 9,163lbs.; rolled beef, 180lbs.; beef powder, 146,292lbs.; beef fat, 24,000lbs.; Neats foot oil, 4,295lbs.

B. A. MYHILL,
Acting Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-37.

Monthly Report No. 55.
JUNE, 1937.

A few winged swarms of the Red Lucust (*Nomadacris septemfasciata*, Serv.) have been reported in the north eastern portion of the Colony during June, the districts included being Lomagundi, Mazoe, Salisbury and Hartley. The swarms have been described mostly as "large."

Specimens examined have been normal swarm phase fliers of the early dry season.

No damage has been reported.

RUPERT W. JACK,
Chief Entomologist.

THE RHODESIA
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(Assisted by the Staff of the Agricultural Department).

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Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Rhodes Inyanga Estate Trout Fishing.—The waters of the Inyangombie River system on the Rhodes Inyanga Estate, will be opened for fishing from the 1st November, 1937, to 31st January, 1938.

The cost of permits, which are obtainable from the Manager of the Estate, P.B. Rusape, or from the office of the Conservator of Forests, P.O. Box 387, Salisbury, will be 5s. per day, 30s. per week or £3 3s. per season.

Applications for more than one permit should give the name in full of each person for whom a permit is required.

The rules governing the fishing in the above waters are as follows:—

1. This permit must be carried while fishing, to be produced on demand by authorised authority.

2. The bearer will be required on request to sign his name and give the number of his permit in a book to be produced by a Native Watcher or Bailiff.

3. All fish less than 10 inches in length from tip of snout to fork of tail must be returned immediately to the water.

4. Not more than one rod may be used at a time.

5. Not more than one hook may be attached to a line.

6. Only a wet or dry artificial fly may be used.

7. Not more than six sizeable fish may be retained by the holder of this permit in any one day.

8. Fishing may only be carried out between the hours of sunrise and sunset.

9. Anglers are earnestly requested to close all gates and extinguish any fires caused by their own action or within their control. No vegetation or fences may be damaged or destroyed, and litter and rubbish should not be left lying about.

10. Failure to conform with these rules may entail the cancellation of this permit in which event the bearer will not be entitled to any refund of monies paid.

Anglers are asked to furnish information as to the locality, number and size of fish captured, on the form provided, and are further requested to furnish information to the Manager of the Estate should any form of illegal fishing be brought to their notice.

Notes from the Game Reserve.—The Game Warden reports that during July, 27 people visited the Reserve. Almost every variety of game except Buffalo was seen and included over 90 giraffe and 20 elephant.

Messrs. Gillespie and Dalrymple took a number of photographs.

Elephant appear to be concentrating round the pans.

About 100 eland are concentrated quite close to the Homestead and Roan Antelope appear to have increased largely as compared with last year.

A number of lions have been seen, including a pride of 14 in the western portion of the Reserve. It is noticeable that these animals do not appear to be intimidated by fires. Natives who are employed in control burning along the new road system saw several in the light of the fires and their spoor next morning showed that they had wandered over the burnt area.

Gas Cartridges to destroy Spring Hares.—About a year ago a number of reports were received from wheat growers in the Charter District complaining of the damage done to young wheat by spring hares. This Department supplied a number of gas cartridges to several different farmers but the reports received indicated considerable difference of opinion regarding their efficiency.

The damage done to wheat in the sand-veld areas every year is very considerable and the Department therefore arranged with the Civil Commissioner at Enkeldoorn that further tests should be made during May this year.

Several farmers were selected of whom five were entirely satisfied with the results. The remaining two considered the results unsatisfactory. The following opinions were expressed by the five who obtained good results:—

(1) The burrows made by spring hares lead to a central cavity above which there is an air hole or emergency exit. The spring hares are only active at night and on returning to their lairs they invariably close their burrows by kicking up the earth a foot or two from the entrance leaving only the emergency exit open.

(2) Gas cartridges are entirely ineffective if placed down the burrow as the gas does not reach the central cavity.

(3) The cartridges, which were made for treating moles, are probably too small to be effective if used singly. Two or more spring hares were found dead in several holes treated

by Mr. M. P. Coetzee when two or three cartridges were used together and, after lighting, were inserted on a piece of plain fencing wire about three feet down the emergency exit. Mr. Coetzee always used a native with an old sack to beat the smoke back from the hole until he had ascertained that none of the other burrows were open and allowed the fumes to escape. When he was satisfied on this point the central hole was closed. Within a few hours it was found that the spring hares were dead and he found that the number in each lair varied from two to seven.

Used in this manner Mr. Coetzee definitely states that the cartridges are certainly successful and that if wheat farmers will only carry out the work properly the damage from spring hares can be reduced.

Imperial Conference of Farmers.—In Australia and other British Dominions opinion is growing that the wealth of the market of the United Kingdom should be devoted to strengthening each unit within the Empire rather than building up the power of the outside world, and so enabling foreign countries to become still greater competitive forces.

It is believed that unless this market wealth is harnessed for the service of the Empire there must be a check to the expansion of agricultural enterprise in the dominions and to both the manufacturing and agricultural industries in Great Britain.

An attempt is to be made to solve the problem, and the producers of Australia, with support of the Federal and State Governments, have convened a conference of the primary producers of Great Britain and the Dominions, to be held at Sydney, New South Wales, in March of next year. Invitations have been issued to the leading organisations of producers in the Empire to send delegates.

As the conference will be held during the celebration of the 150th anniversary of the first settlement of Australia, a series of interesting tours has been arranged to enable the delegates to visit the chief points of interest and to witness the elaborate pageantry which is to be held in honour of the

early pioneers. Opportunity will also be afforded delegates to visit the principal cattle raising districts, sheep stations, wheat areas, dairy, fruit-growing and kindred agricultural and pastoral centres. The privilege of free travel over the railway system is also to be extended to the visitors.

The organising work of the Conference is in the hands of a committee of Australian producers, under the chairmanship of Mr. M. P. Dunlop, a member of the New South Wales Legislative Council, and a prominent leader in agriculture. He is general president of the Primary Producers' Union of New South Wales and closely identified with a number of other important societies devoted to the development of farming.

The agenda prepared for the Conference covers a wide range of subjects of interests common to the producers of the Empire. It is to be submitted to the leading organisations of producers in the United Kingdom and the Dominions for suggestions and amendment, if necessary, as it is desired that the conference shall be representative of the Empire as a whole and not of any particular unit.

The Conference, it is expected, will result in the establishment of a committee to safeguard the interests of producers, especially in cases where governments are drafting trade treaties. Something in the nature of a liaison committee has already been suggested by several of the Dominions. The object of the Conference is to treat each problem from an Empire point of view. Each section will make its contribution within the limitations imposed by its own needs, and in this way, it is anticipated, a platform, consistent with the common aims of Empire farmers, will be drawn up.

Official Weights of Produce.—The prescribed weight of the contents of a bag of the under-mentioned articles shall be:—

	lb.
Barley	150
Beans, all varieties	200
Bran, maize	100
Bran, wheaten	100

Buckwheat	150
Cowpeas	200
Cockle	200
Cotton seed, delinted	120
Cotton seed, undelinted	90
Hominy chop	180
Kaffir corn	200
Linseed	200
Maize	200
Maize, crushed	180
Maize, flour	180
Maize rice or maize grit	190
Manna	200
Meal, Boer	200
Meal, germ	150
Meal, maize and grades	180
Meal, rye	200
Monkey nuts	65
Monkey nuts, ground	100
Monkey nuts, shelled	180
Munga or inyouti	200
Oats	150
Oats, crushed	110
Onions	120
Pollard	150
Potatoes	150
Potatoes, sweet	120
Rapoko or rukweza	200
Rye	200
Samp	180
Sunflower seed	125
Wheat	200

Report of the Division of Plant Pathology

FOR YEAR ENDING DECEMBER, 1936.

By G. M. Wickens, Ph.D., D.I.C.,
Plant Pathologist, Tobacco Research Station, Trelawney,
(late Assistant Plant Pathologist, Department of Agriculture)

Introduction.—Up to 1st September, 1936, the routine duties and advisory work of the laboratory, and investigation of diseases of crops other than tobacco, were carried out by the writer. On this date the Senior Plant Pathologist returned to the laboratories in Salisbury, and the writer assumed duty as Plant Pathologist at the Tobacco Research Station, Trelawney. At the end of October the Senior Plant Pathologist left on long leave, and since that date the writer has, as far as possible, continued to deal with specimens sent in for diagnosis and advice re control measures, and to keep in touch generally with Plant Pathological matters of importance to the Colony.

This Report therefore outlines the general Plant Pathological work carried out by the writer during 1936 with the exception of the months September and October, with brief mention of records made by the Senior Plant Pathologist during these two months.

Routine.—In the period ending 1st September, 177 specimens were examined. Of these 146 were sent or brought to the laboratory for diagnosis and advice, and the remainder personally collected. Tobacco specimens numbered 36, the diseases recorded including wildfire, angular spot, frenching, mosaic scorch, and a disease of unknown origin characterised by the development, on leaves of plants in the latter stages of growth, of small brown spots which usually later turn white.

During September and October 8 specimens were submitted, and were dealt with by the Senior Plant Pathologist, who also made collections of wheat rusts from the plots at Hillside Experimental Station, from the Citrus Estate, Mazoe, and from the Felixburg district.

In November and December 18 specimens were submitted to the writer for advice, 13 of them being diseases of tobacco.

New records for the Colony include Armillaria root rot of apricot, a dark brown rot of banana stem and pseudostem associated with *Macrophomina phaseoli* (Maubl.) Ashby, anthracnose of Antirrhinum (*Colletotrichum antirrhini* Stew.), leaf spot of cowpea (*Septoria vignae* P. Henn), green ear disease of *Pennisetum spicatum* (*Sclerospera graminicola* (Sacc.) Schroet.), anthracnose of egg plant (*Colletotrichum atramentarium* (Berk. and Br.) Taub.), and streak disease of maize, rapoko grass (*Eleusine indica* Gaertn.) Rhodes grass (*Chloris gayana* Kunth) and kokomo (*Rotboellia exaltata* L.)

GENERAL OBSERVATIONS.

Tobacco.—The early part of the season 1935-1936 was characterised by unusually dry weather conditions, and, presumably in consequence, no specimens of parasitic diseases of tobacco were received until towards the end of January. From then onwards generally, rainy periods were closely followed by the arrival at the laboratory of numbers of diseased leaves, wildfire being predominant.

Two types of injury of an unusual nature are considered worth recording.

From two farms in the Inyazura district tobacco seedlings with symptoms closely simulating those of wildfire were received. Very small central whitish or brown dead areas were surrounded by conspicuous pale green to pale yellowish green "haloes," the dead areas and surrounding "haloes" being exactly similar in size to those of early wildfire infections. Both microscopical examination and the plating out of affected leaf areas failed to reveal the presence of bacteria, and insect (probably capsid bug) injury is suspected as being the cause.

Further examples of another uncommon type of injury to growing tobacco have been received. The symptoms, which closely simulate those of the virus disease known as "Kromnek," were necrosis of midribs and veins of the leaves extending to a greater or less extent in the main stem, with extensive puckering of the leaf laminae. In all cases enquiries showed that the plants submitted were taken from the borders of a small affected area in which the central plants were killed, that the trouble appeared suddenly, that no further spread occurred, and that a short while before the injury was noticed a severe lightning storm had passed over the farm. In the light of these observations, lightning is believed to have been the causal agent.

The disease mentioned above and referred to in last year's Report, in which small circular brown spots (which usually later turn white and become inhabited by a species of *Phyllosticta*, but are at first sterile) develop mostly on the middle leaves of well grown plants, appeared to be rather prevalent. The cause is as yet unknown.

A severe outbreak of a disease believed to be Granville wilt was observed by the writer on a farm in the Macheke district, causing at a rough estimate 50 per cent. loss of leaf from an eight acre land. The symptoms agreed exactly with those of Granville wilt, and dense masses of bacteria were constantly found in discoloured vessels right up to the tops of affected stems. Pure cultures were prepared, and these in outward appearance agreed with *Bacterium solanacearum*, the cause of Granville wilt. Unfortunately the writer's time was so fully occupied with other matters that the question could not be carried further, and confirmation of the diagnosis by detailed examination of the bacteria and by inoculations is lacking.

Maize.—Once again it must be recorded that cob rot of maize (especially that caused by the fungus *Gibberella saubinetii*) was prevalent, and as long as the practice of leaving old stalks in and around the lands until long after the new lands are sown is continued (and the writer has this season seen old lands, with stalks still standing, adjacent to lands of well grown plants), it is unlikely that any reduction of the considerable annual losses will occur. Some of the

seed sown is of poor quality, and greater attention to seed selection would result in improved stands and yields. This question is more fully discussed in a latter section.

In late December and the early part of February, specimens were received from the Glendale and Arcturus districts of young plants affected by a hitherto unrecorded disease. The writer was informed that the trouble was fairly prevalent in the Mazoe Valley, and himself saw the disease in small areas of lands in the Arcturus district. The disease is characterised by the unfolding of almost pure white leaves, those already unfolded remaining green, and is symptomatically similar to a disease described from Florida under the name "White bud," and stated there to be curable by the application of zinc sulphate to the soil. Later, with the onset of good rains, many cases of partial recovery were observed, the white leaves taking on a normal green colour, but the development of such plants was seriously retarded. Other plants, more severely affected, made no recovery.

No organism was found to be associated with the disease, and it is considered that the primary cause was drought, resulting in either a deficiency in the soil of some element such as zinc or possibly (as suggested by the observations of Mr. T. J. Mossop, communicated to me by Mr. M. C. Mossop, Entomologist) to some deleterious effect exerted by the presence in the soil of incompletely rotted sunn-hemp.

Other Crops, etc.—A disease of the tung oil tree, in which the young trees are stunted and their foliage takes on a bronze discolouration, was brought to the writer's notice. This disease too is similar in its symptoms to one described from Florida, and stated there to be curable by zinc sulphate treatment. As with the "white bud" disease of maize, no time was available for an investigation of the cause of this disease in Rhodesia.

Common scab of potatoes appears to become increasingly prevalent and is occasioning some concern. Occasionally high percentages of infection have been observed in imported seed tubers, and the writer considers that the restriction of imports of seed tubers to certificated consignments is highly desirable on these and other grounds. Internal brown fleck

is also common, and the prevalence of these two diseases is largely ascribable to the practice of growing potatoes in soil deficient in humus.

It has recently been brought to the writer's notice that much of the wheat grown in the Colony during the past season was so heavily infected with smut (presumably "bunt," or "stinking smut"), that the quality of the flour milled therefrom was considerably lowered. Bunt can to a very large extent be controlled by treatment of the seed with copper carbonate or the proprietory organic mercurial dusts, and farmers are urged to treat their seed since the writer understands that it is likely that in future, lower prices will be paid for crops carrying appreciable smut infection.

Research.—The results obtained from a previous experiment, together with observation of the rather poor quality of numbers of maize seed samples examined, led the writer to lay down a series of elaborate experiments under field conditions to access the effect of a number of factors on maize seed germination, seedling vigour, and yield of grain.

The following were the main results obtained:—

(*a*) Seedlings derived from heavy seeds were appreciably more vigorous than those from lighter seeds:

(*b*) injury to the seed coat caused a marked reduction of seedling vigour;

(*c*) slight infection of the seed with the seedling blight organism *Gibberella saubinetii*, although soil conditions in all experiments were unfavourable to the fungus and no fungal attack of the seedlings was seen, also caused a reduction of seedling vigour;

(*d*) nearly perfect stands gave a much greater yield of grain than imperfect stands obtained from the sowing of an ordinary commercial sample of seed at normal spacing;

(*e*) seed treatment with a number of proprietory compounds caused no improvement of germination, seedling vigour, or yield.

The results obtained clearly indicate that much of the maize seed sown in the Colony contains a large proportion of seeds incapable of producing vigorous seedlings, and much greater attention to the selection of seed would undoubtedly result in greatly improved stands and consequently higher yields.

The negative results obtained from seed treatment should by no means be taken as indicating that the practice is useless. Conditions were against the development of *Gibberella* seedling blight, and if the weather had been different or a proportion of the seeds used had been infected with *Diplodia zeae*, considerable benefit might have been derived by treatment. Seed treatment, the practice costing as it does only about 2d. per acre, can therefore be recommended as a cheap form of insurance.

In the Annual Report of 1935, reference was made to preliminary observations and experiments on a disease of maize symptomatically similar to the virus disease known as "streak," which is transmitted from plant to plant by the feeding of the leaf-hopper *Cicadulina mbila* Naude, and which has been known for some years in South and East Africa.

The disease again made its appearance on farms in the Umtali district during the season 1935-1936, and in January the writer, with Mr. A. Cuthbertson, Entomologist, succeeded in capturing a number of specimens of *Cicadulina mbila* from a field of maize affected by the disease. The jassids were brought to Salisbury alive, and enabled the writer in a series of experiments to demonstrate the identity of the disease with Cicadulina-transmitted streak.

Although this disease has been extensively studied in South and East Africa, one aspect of the problem, of importance to its control, has received comparatively little attention —that is, the role that may be played by various wild grasses in carrying over the disease, especially from one season to the next. From time to time the writer has seen symptoms very similar to those of streak in maize on the grasses kokoma (*Rotboellia exaltata* L), Rhodes grass (*Chloris gayana* Kunth.), and rapoko grass (*Eleusine indica* Gaertn.) grow-

ing in and near affected maize lands. The writer therefore deemed it worth while, especially in view of the fact that the first two of these grasses are perennials, to spend much of his time in experimental work to determine the suspectibility or otherwise of these grasses to maize streak.

Unfortunately, with the writer's transfer to the Tobacco Research Station at the beginning of September, these studies had to be brought to a premature close, and the possible part played by these grasses in carrying over the disease has not been fully determined. Nevertheless, the following facts new to science have been established:—

(*a*) Maize streak is readily transmissable to *Rotboellia exaltata*, and, in the reverse direction, naturally occurring streak of *Rotboellia exaltata* is readily carried to maize through the agency of *Cicadulina mbila*. The symptoms produced were indistinguishable, and it is concluded that maize streak and kokoma streak are identical.

(*b*) Jassids that had fed on streak maize and streaked kokoma, when fed on well-developed plants of Rhodes grass and rapoko grass, caused the development in these latter grasses of no more than very slight and transient symptoms, although capable of producing severe symptoms in maize and kokoma. But when fed, by a specially developed technique, on the first unfolding leaves arising from germinating seeds of these two grasses, a full development of the characteristic symptoms appeared on the later unfolding leaves.

It is therefore concluded that kokoma can carry the virus of maize streak, and, being perennial, may serve to carry the disease over from one season to the next.

Rapoko grass and Rhodes grass are also, at least to some extent, susceptible to the same virus, and in districts where the disease is liable to occur it is recommended that, especially just before the seed is sown, particular attention be paid to the eradication of these grasses.

At various times, accompanied by Mr. M. C. Mossop or Mr. A. Cuthbertson, Entomologists, the writer has carried out extensive field observations on the occurrence of the disease. While it has been seen on a very few plants in districts widely distributed throughout the Colony, it has so far as is known only reached epidemic proportions on irrigated lands in the Umtali district. Since environmental conditions have little effect on the development of the disease once a plant is fed upon by a viruliferous jassid, it would appear that except where irrigation is practised, conditions are unfavourable for the multiplication of *Cicadulina mbila* and consequently for spread of the disease.

Travelling and Miscellaneous.—Owing to the demands made on the writer's time by the research work undertaken, but little travelling of a purely advisory nature was possible. Visits were made to farms in the Umtali district in connection with the investigation of streak disease of maize, to the Macheke district to observe a suspected outbreak of Granville Wilt of tobacco, to farms in the Arcturus and Salisbury districts, and to the Mazoe Citrus Estate, Tobacco Research Station, and Hillside Experiment Station.

In September and October the Senior Plant Pathologist visited the Hillside Experimental Station, Mazoe Citrus Estate, and farms in the Felixburg district, for inspection of wheat diseases, and a farm in the Arcturus district for inspection of tobacco seed beds.

The usual exhibit was placed on the Salisbury Show, consisting largely of living specimens of a number of types of plant diseases, with explanations of how they spread and how they may be controlled.

Report on the Seventeenth Annual Southern Rhodesia Official Egg Laying Test, 1936-1937.

Held at the Government Poultry Station, Salisbury, Southern Rhodesia.

By H. G. Wheeldon, Dip.Agric., Poultry Officer, and G. H. Cooper, Dip.Agric., Assistant Poultry Officer.

The Seventeenth Laying Test was run as usual for forty-eight weeks, from 1st March, 1936, to 30th January, 1937, and was one of the most successful ever held in the Colony.

This test may be considered the last of a series, for it will be the last to be held under the system of calculating the positions on the total weight of 2 oz. eggs laid by birds, and also it will probably be the last where replacements of birds that succumbed were allowed.

The method of calculating the positions on the weight of eggs laid was originally adopted with the first test to encourage the production of larger eggs. This object, we feel, has now been fully achieved—in fact, there is a danger of forcing pullets to lay too large an egg and thus increasing mortality from this cause. From now on, therefore, the positions will be calculated on the number of 2 oz. eggs laid, allowing a smaller egg—viz.: $1\frac{7}{8}$ oz. or $1\frac{3}{4}$ oz.—to count for the first ten weeks, in order to avoid this excessive forcing of pullets for large eggs. In addition, in future the four leading hens in each pen of five only will count for position, and no replacements will be allowed for birds that succumb.

Accommodation.—The pen accommodation at the Government Poultry Station provides for 200 birds in single covered pens of the most up-to-date and approved design.

Entrants.—There were 30 pens of five birds entered in this test by 19 breeders; of these, 22 pens were entered by 14 Rhodesian breeders, 6 pens by 4 Union breeders, and 2 pens by one Northern Rhodesian breeder.

The competition was divided into two sections. Section 1 consisted of the competition between pens of 5 birds, and was divided into heavy and light breed sections. There were 8 entries in the heavy breed section: 5 pens for 3 Southern Rhodesian breeders, and 3 pens from 3 Union breeders. The light breed section consisted of 22 pens, of which 17 were entered by 12 Southern Rhodesian breeders, 3 by 3 Union of South Africa breeders, and 2 by one Northern Rhodesian breeder.

Section 2 comprised a single bird competition. Each breeder in both heavy and light breed sections entered a bird in its respective section in this competition also.

In the pen competition and the single bird competition together there were therefore 180 birds under test.

Breeds.—The three main utility breeds which have done so well in this Colony were well represented—in fact, they comprised the whole test, with the exception of one pen.

The breeds represented were as follows:—

HEAVY BREEDS.

Australorps.—4 pens and 4 single birds of these 2 were from Southern Rhodesia and 2 from the Union.

Rhode Island Reds.—4 pens and 4 single hens of these 3 were from Southern Rhodesia and 1 from the Union.

LIGHT BREEDS.

White Leghorns.—21 pens and 21 single birds, 16 from Southern Rhodesia, 3 from the Union and 2 from Northern Rhodesia.

Black Leghorns.—1 pen and 1 single bird from Southern Rhodesia.

The season was normal, as far as the weather was concerned, and this possibly assisted the birds to produce well at all times.

The analysis of the egg production of the various breeds is shown in the following table:—

Egg Production	W. Leghorns	B. Leghorns	R.I. Reds	Australorps
50—100	2	2	—	1
101—150	10	2	1	—
151—200	36	—	8	11
201—250	71	1	8	10
Over 250	7	1	7	2
Over 300 in 52 weeks	—	—	2	1

The excellent production of all breeds will be noted from this table especially the high percentage of birds laying 200 eggs and over, which numbered 60 per cent. of the birds competing. This must be considered very satisfactory in a test of 48 weeks.

White Leghorns.—The White Leghorns were very well selected and maintained the excellent reputation of this popular breed. The egg production was very good and the quality of the product also satisfactory. The size of egg being uniformly large and the standard of 2 oz. eggs well maintained. The texture and quality of shell was on the whole good, but there is room for improvement in this respect.

The winter production of this breed was not so good as that of the dual purpose breeds but was very close. The summer production was extremely heavy.

The best White Leghorn pen was Pen 17 owned by Mr. D. Jarvis of the Mayfair Poultry Stud Farm, Gwelo. These five birds laid 1,087 2 oz. eggs and 42 under 2 oz. eggs in the 48 weeks. The weight of 2 oz. eggs on which the positions were calculated was 150 lbs. 4 14/16 oz. This pen enjoyed good health throughout the period of the test and were a good type of layer. Average per bird, 226 eggs.

In the second position was Pen No. 23 owned by Mr. W. A. Bull of Fairholme Poultry Farm, Umtali, which laid 1,075 eggs 2 oz. and 14 under 2 oz. eggs, the total weight of

the 2 oz. eggs being 150 lbs. 1 14/16 oz. Two birds succumbed in this pen and were replaced. Average per bird, 218 eggs.

The third position was taken by Pen 18 owned by Mr. E. E. C. Green of Kloof Stud Farm, Bulawayo. These birds laid 1,064 2 oz. eggs and 66 under 2 oz. eggs the large eggs weighing 150 lbs. 1 3/16 oz. This pen went right through the test without sickness or the loss of a bird. Average per bird, 226 eggs.

It will be noticed how exteremely close these first three pens are in weight of eggs laid, in fact there is not more than $3\frac{3}{4}$ ozs. or less than 2 eggs between the first and third positions.

Black Leghorns.—The one pen of Black Leghorns laid fairly well but was rather mixed there being very good and some rather poor layers in the pen. They finished 21st in the Light Breed section after being well up during the first half of the Test.

Rhode Island Reds.—In the Heavy Breed section the Rhode Island Reds, Pen No. 6 owned by Miss Higginson of M'Sonneddi, Southern Rhodesia, laid remarkably well by producing 1,077 2 oz. eggs and 108 under 2 oz., the former weighing 144 lbs. 15 9/16 oz. These birds were good in type and colour and were fine layers of dark brown eggs of good quality, texture and shape. One bird in this pen, No. 27, was the best hen of the test. Average per bird, 237 eggs.

The third place in the Heavy Breed section was taken by Pen 5 of Rhode Island Reds owned by Miss Higginson. This pen laid almost as well as the first pen by producing 1,023 2 oz. eggs and 194 under 2 oz., the former weighing 135 lbs. 12 4/16 oz. This pen was most prolific but the eggs were smaller than those laid by Pen 6. Average per bird, 243.4 eggs, a record for all breeds on these tests.

Bird No. 21 in Pen 5 was the second best hen on the test.

Australorps.—The best pen of Australorps was Pen 1 owned by Mr. Dan Jacobs of Germiston, Transvaal, which obtained 2nd place in the Heavy Breed section by laying 970 eggs over 2 oz. and 3 under 2 oz. eggs, the former weighing 143 lbs. 0 15/16 ozs. As will be seen these birds laid fewer

eggs than the third pen of Rhode Island Reds, Pen 5, but the weight was greater. Their eggs were undoubtedly large right from the commencement of the test. This pen is owned by a well-known Union breeder. Average per bird, 194.6 eggs.

Single Bird Competition.—In addition to the pen test a competition for single birds was run at the same time. The principle adopted was that each competitor should send in a single bird of the same breed for every pen of birds entered.

On the whole the Single birds were very carefully selected and in most cases were the very best pullet available on the farm.

In the Heavy Breed section the leading single bird No. 152 was an Australorp owned by Mr. Raynor of Darwendale, Southern Rhodesia which produced 280 2 oz. eggs in the 48 weeks. This is the same bird that produced 301 2oz. eggs in the 52 week period and was the best bird in the Single Bird Competition.

Second place was taken by Bird No. 155, a Rhode Island Red owned by Miss Higginson which laid 266 2 oz. eggs and 3 under 2 oz. The third position went to another Australorp owned by Mr. H. Scully of Bellevue, Bulawayo, which laid 247 2 oz. eggs and 2 under 2 oz. eggs.

In the Light Breed section the first position was taken by a fine Black Leghorn No. 160 owned by Mr. A. V. Johnson of Duiker Poultry Farm, Salisbury, which laid 253 2 oz. eggs. This bird led from the commencement of the test.

Second place was held by a White Leghorn No. 173 the property of Mr. W. A. Bull which laid 246 2oz. and 2 under 2 oz. eggs. The third position was taken by White Leghorn No. 175 owned by Mr. R. Raynor which produced 236 2oz. eggs all over the 48 week period.

These results are very satisfactory especially when the fine size of egg is taken into consideration.

The following list shows a comparison of the results of the tests from the commencement in 1920 to date.

Total Number of Weight of Eggs.

Year	No. of Birds	Duration, Weeks	2oz. & Over	Under 2oz.	Total	Weight: Lbs.	Weight: Ounces
1920-21	100	45	15,208	2,859	18,067	2,361	14 13/16
1921-22	100	48	14,632	2,743	17,375	2,266	10 9/16
1922-23	100	48	12,730	2,097	14,827	1,924	11 5/16
1923-24	100	48	15,392	2,717	18,109	2,372	14 9/16
1924-25	100	44	16,577	1,356	17,933	2,387	8 2/16
1925-26	100	48	17,210	1,761	18,971	2,533	3 1/16
1926-27	100	48	16,284	2,272	18,556	2,454	8 14/16
1927-28	100	48	17,483	1,668	19,151	2,571	11 12/16
1928-29	100	48	16,725	1,539	18,264	2,464	14 13/16
1929-30	95	44	15,403	517	15,920	2,245	10 4/16
1930-31	200	48	36,303	1,444	37,747	5,197	6 13/16
1931-32	200	48	28,910	4,488	33,398	4,393	4 15/16
1932-33	138	48	22,140	1,660	23,800	3,204	10 12/16
1933-34	100	48	16,416	964	17,380	2,383	12 14/16
1934-35	100	48	15,877	1,517	17,394	2,329	7 11/16
1935-36	138	48	25,358	2,682	28,040	3,788	15 14/16
1936-37	180	48	33,547	2,493	36,040	4,929	6 12/16

The Breed Records of competing Pens (5 birds) to date.

Year	Breed	Pen No.	Best 2oz. Eggs	Best all Eggs	Average per Bird, all Eggs
1921-22	Barred Rock	3	384	412	82.4
*1924-25	Blk. Mendels	18	723	847	169.4
1924-25	Blk. Minorcas	12	902	907	181.4
1924-25	Australorps	3	1,110	1,153	230.6
1925-26	Wyandottes Wh.	4	955	——	191.0
1927-28	Ancona	16	848	932	186.4
1927-28	Wh. Leghorn	14	——	1,188	237.6
1928-29	Wh. Wyandotte	10	——	970	194.0
*1929-30	Blk. Leghorn	12	879	881	176.2
1932-33	R.I. Red	5	1,095	——	219.0
1935-36	Wh. Leghorn	9	1,158	——	231.6
1936-37	R.I. Red	5	——	1,217	243.4

* 44 week tests only.

Heavy Breeds to the Fore.—A point of great interest in both the pen and single bird competition is the fine performance put up by all the heavy breed birds. Individual birds of the Rhode Island Red and Australorp breeds were well ahead of any individuals in the Light Breed Section. The leading pen totals too were the equal of the leading light breeds. Many people who consider these breeds not very well suited to Rhodesian conditions and climate will it seems have to alter their views. Amongst good strains of these breeds broodiness is not troublesome.

Average eggs per bird for the Tests to date are as follows:

Year	Duration: Weeks	Heavy Breeds	Light Breeds	All Breeds
1920-21	45	nil	180.67	180.67
1921-22	48	147.1	188.0	173.75
1922-23	48	130.8	149.0	143.59
1923-24	48	164.8	186.5	181.09
1924-25	44	181.2	178.8	179.33
1925-26	48	180.3	194.6	189.71
1926-27	48	167.2	195.4	185.56
1927-28	48	170.7	196.7	191.51
1928-29	48	166.9	198.3	182.64
1929-30	44	159.6	172.1	167.5
1930-31	48	177.6	193.4	188.73
1931-32	48	153.6	170.8	166.99
1932-33	48	170.3	175.0	172.3
1933-34	48	158.9	180.2	173.8
1934-35	48	152.0	177.8	173.9
1935-36	48	191.0	205.7	203.1
1936-37	48	209.1	197.0	200.2

Note: First five tests commenced April 1st, thereafter tests have commenced on March 1st except the Tenth which commenced on April 1st.

Winter Test.—A special test extending over 16 weeks from the commencement of the test on March 1st to the end of June is held in conjunction with both sections of the 48 week test and awards given for the best performances during that period.

The object of this special test is to encourage the breeding of birds that will produce well during the time when

eggs are most scarce. In this respect the heavy breeds were again to the fore as it is well known they are excellent producers at this time of year and not so liable to partial moults or to be put off the lay by adverse weather conditions.

The leading pen in the Winter Test in the Heavy Breed Section was Pen 6, the winning pen of Rhode Island Red owned by Miss Higginson which laid 421 2 oz. eggs and 32 under 2 oz. eggs in the 16 weeks. The second pen was Pen 7, Rhode Island Reds owned by the Ardenlee Poultry Farm, Nottingham Road, Natal, which laid 372 2 oz. and 5 under 2 oz eggs. The third position fell to Pen 5, Rhode Island Reds of Miss Higginson's which produced 401 2 oz. eggs and 58 under 2 oz. eggs.

In the Light Breed Section the first position was taken by Pen 25, White Leghorns owned by Mr. Raynor which produced 342 2 oz. and 12 under 2 oz. eggs. Second place fell to Pen 23 also White Leghorns, the property of Mr. W. A. Bull with a record of 333 2 oz. eggs and 10 under 2 oz. eggs. Third position was taken by Pen 28, a White Leghorn pen owned by Mr. Brock of Bindura, Southern Rhodesia, which laid 308 2 oz. and 20 under 2 oz. eggs.

In the Single Bird Competition the leading bird in the Heavy Breed Section for the Winter Test was Australorp No. 152 belonging to Mr. Raynor which in the 16 weeks had laid the excellent total of 99 2 oz. eggs. Second was Ardenlee Poultry Farm, Rhode Island Red No. 157 with a total of 86 2 oz. eggs and third Mr. Dan Jacobs, Australorp No. 151 with a record of 84 2 oz. eggs. In the Light Breeds, Mr. Johnson's Black Leghorn No. 160 led the field with a record of 93 2 oz. eggs. Second was the White Leghorn No. 171 owned by Captain Waller of Salisbury with 88 2 oz. and 6 under 2 oz. eggs. Mr. Raynor's White Leghorn No. 175 obtained third place with a record of 78 2 oz. eggs.

These are all excellent records for winter production, especially is the size of egg to be noted for only 6 under 2 oz. eggs were laid by these 6 leading pullets during their first 16 weeks of production. Amongst the pens also there were very few under 2 oz. eggs laid.

The winning teams (5 birds) of the Winter Tests (16 weeks) to date are as follows:—

Year	Breed	Pen No.	2oz. & Over	Under 2oz.	Total	Weight: Lbs.	Ounces
1920-21	Wh. Leghorns	3	311	3	314	42	12 11/16
1921-22	R.I. Red	4	278	5	283	38	2 13/16
	Australorp	7	271	55	326	39	14 1/16
	Wh. Leghorn	11	342	47	389	48	9 11/16
1922-23	Australorp	5	303	2	305	40	10 8/16
	Wh. Leghorn	10	271	48	319	38	14 7/16
1923-24	R.I. Red	3	341	—	341	49	8 15/16
	Wh. Leghorn	16	403	5	408	54	11 14/16
1924-25	Australorp	3	431	5	436	56	1 1/16
	Australorp	2	416	25	441	56	8
	Wh. Leghorn	11	409	32	441	54	9 12/16
1925-26	Australorp	7	383	21	404	55	1 4/16
	Wh. Leghorn	10	355	7	362	46	13 1/16
	Wh. Leghorn	9	289	131	420	51	5 8/16
1926-27	Australorp	4	353	13	366	46	3 5/16
	Wh. Leghorn	20	344	12	356	44	11 2/16
1927-28	Australorp	1	362	7	369	48	4 13/16
	Ancona	16	364	29	393	49	6 8/16
	Wh. Leghorn	8	336	41	377	47	8 3/16
1928-29	Australorp	3	356	23	379	50	13 15/16
	W. Wyandotte	10	355	43	398	49	9 7/16
	Wh. Leghorn	15	391	8	399	51	1 13/16
1929-30	Australorp	6	385	2	387	52	13 15/16
	Wh. Leghorn	14	332	8	340	45	2 5/16
1930-31	R.I. Red	8	394	25	419	54	1
	Wh. Leghorn	30	406	—	406	57	5 9/16
	Wh. Leghorn	34	402	23	425	55	15 11/16
1931-32	Australorp	1	319	6	325	42	14 15/16
	Wh. Leghorn	30	335	30	365	45	11 8/16
1932-33	Australorp	3	413	6	419	54	12 3/16
	Wh. Leghorn	17	345	19	364	45	8 1/16

Year	Breed	Pen No.	2oz. & Over	Under 2oz.	Total	Weight: Lbs.	Ounces
1933-34	Australorp	1	293	8	301	38	10 8/16
	Australorp	2	262	43	305	37	4 7/16
	Wh. Leghorn	10	317	23	340	43	11 6/16
1934-35	Australorp	1	276	3	279	37	11 12/16
	Wh. Leghorn	4	374	7	381	49	4 12/16
	Wh. Leghorn	15	358	29	387	48	13 12/16
1935-36	Australorp	2	387	—	387	54	9 4/16
	Wh. Leghorn	9	397	3	400	54	8 9/16
1936-37	R.I. Red	6	421	32	453	59	11 3/16
	R.I. Red	5	401	58	459	58	1 13/16
	Wh. Leghorn	25	342	12	354	46	15 14/16
	Wh. Leghorn	13	313	46	359	44	15 14/16

On examining the records of the Winter Test it will be noted that in the Heavy Breed Section which almost entirely consists of Rhode Island Reds and Australorps that the latter have won this competition 13 times to 3 of the former, but that the Rhode Island Reds have the best and second best records of all breeds.

It will also be noticed that the White Leghorns which have comprised about 99 per cent. of the Light Breed Section have beaten the winners of the Heavy Breed Section in both numbers and weight of eggs laid in 8 competitions whereas the Heavy Breeds have been successful in 5 competitions. In three tests the White Leghorns led on numbers of eggs and the Heavy Breeds on weight of eggs. From this is will be seen that the White Leghorn can more than hold its own as a Winter layer in this climate and is in fact, still ahead of the other breeds in this country in all round efficient egg production, though of recent years good strains of Australorps and Rhode Island Reds are seriously challenging this supremacy.

The Feeding.—It is not proposed to give a detailed list of the amount of feeds consumed or their cost for this is not the object of this egg-laying test.

The birds were fed dry mash in hoppers available at all times. Grain consisting of Pearl millet known as "N'youti or Munga" (*Pennisetum typhoides*) was fed in the early morning in scratching litter approximately 1 oz. per bird. In the afternoon the grain mixture of maize, sunflower seed and munga was fed in the litter at the rate of 1½ ozs. per bird.

Water was supplied by automatic device and was always on hand. Grit, shell and charcoal were always present in hoppers. The ration used was as follows:—

Dry Mash.

Wheaten Bran	125 lbs.
Pollard	125 lbs.
White Maize Meal	100 lbs.
Meat Meal	50 lbs.
Blood Meal	50 lbs.
Lucerne Meal	50 lbs.
Mineral Mixture	25 lbs.

Grain.

Cracked White Maize	350 lbs.
Sunflower Seed	75 lbs.
Munga	75 lbs.

A mineral mixture of Bone Meal 55 lbs., common salt 20 lbs., ground limestone 20 lbs., Sulphur 5 lbs. was added to the mash at the rate of 5 per cent.

White maize meal was used because yellow is not always obtainable. The meat meal used contained approximately 50 per cent. protein and the blood meal 72 per cent. protein. Fresh green cut lucerne was given twice daily.

During periods of moult or sickness a little of the mash was fed daily as a wet mash usually mixed with boiled linseed. This ration proved very satisfactory being palatable and not forcing though containing adequate constituents for the highest production; it may, therefore, be thoroughly recommended for use here for all classes of laying stock.

The following table shows the best individual records for each test since the commencement.

Year	Breed	Hen No.	Duration: Weeks	2oz. & Over	Under 2oz.	Total	Weight: Lbs.	Ozs
1920-21	Wh. Leghorn	63	45	256	8	264	33	15 1/16
1921-22	W. Wyandotte	4	48	197	25	222	28	1 9/16
	Wh. Leghorn	55	48	243	6	249	33	9 8/16
1922-23	R.I. Red	27	48	171	2	173	23	1 10/16
	Wh. Leghorn	75	48	229	1	230	30	9 2/16
1923-24	Australorp	8	48	120	114	234	28	5 2/16
	Wh. Leghorn	76	48	254	—	254	34	5 8/16
1924-25	Australorp	8	44	241	2	243	33	9 15/16
	Wh. Leghorn	54	44	241	18	259	32	14 13/16
1925-26	Australorp	27	48	104	133	237	28	1 4/16
	Wh. Leghorn	44	48	32	230	262	29	1 11/16
1926-27	R.I. Red	10	48	240	1	241	34	3 6/16
	Wh. Leghorn	50	48	181	78	259	31	8 4/16
	Wh. Leghorn	98	48	252	6	258	34	2 1/16
1927-28	Australorp	108	48	229	1	230	31	9 6/16
	R.I. Red	118	48	221	—	221	31	2 1/16
	Wh. Leghorn	141	48	244	15	259	33	5 7/16
1928-29	R.I. Red	205	48	191	64	255	31	13 5/16
	W. Wyandotte	248	48	240	—	240	32	3 8/16
	Wh. Leghorn	297	48	244	1	245	32	14 7/16
1929-30	R.I. Red	315	44	231	—	231	31	13 15/16
	Wh. Leghorn	395	44	229	—	229	33	8 1/16
1930-31	Australorp	27	48	280	1	281	37	8 1/16
	R.I. Red	44	48	252	2	254	34	14 4/16
	Blk. Leghorn	66	48	220	—	220	30	3 4/16
	Wh. Leghorn	170	48	263	2	265	36	10 12/16
1931-32	Australorp	206	48	216	6	222	30	3 10/16
	Blk. Leghorn	249	48	189	31	220	28	0 7/16
	Wh. Leghorn	349	48	234	12	246	32	7 11/16
1932-33	R.I. Red	421	48	239	—	239	32	2 8/16
	Wh. Leghorn	444	48	220	—	220	33	9 1/16
	Wh. Leghorn	494	48	205	37	242	30	0 13/16
1933-34	Australorp	613	48	228	2	230	34	9 8/16
	Wh. Leghorn	646	48	230	—	230	32	13 12/16

Year	Breed	Hen No.	Duration: Weeks	2oz. & Over	Under 2oz.	Total	Weight: Lbs.	Weight: Ozs
1934-35	Australorp	702	48	246	—	246	33	5 12/16
	Wh. Leghorn	773	48	210	50	260	32	0 11/16
1935-36	Australorp	810	48	261	6	267	37	1 14/16
	R.I. Red	811	48	254	19	273	35	4 8/16
	Wh. Leghorn	831	48	254	13	267	36	10 9/16
	Wh. Leghorn	844	48	252	—	252	37	15 6/16
1936-37	R.I. Red	27	48	293	3	296	39	9 10/16
	R.I. Red	27	52	315	3	318	42	13 7/16
	R.I. Red	21	48	283	2	285	38	12 15/16
	R.I. Red	21	52	306	2	308	41	15 14/16
	Australorp	152	48	280	—	280	41	12 6/16
	Australorp	152	52	301	—	301	44	13 1/16
	Blk. Leghorn	160	48	253	—	253	39	10 1/16
	Wh. Leghorn	171	48	253	16	269	35	4 12/16
	Wh. Leghorn	130	48	263	—	263	36	6 1/16

Mortality.—It is very noticeable in reading reports of laying trials from Overseas that in most countries the death rate has become higher and higher during the last 10 years until to-day it stands at a most formidable percentage in some cases up to 50 per cent. in the pullet year.

Figures taken over the last 11 years in Southern Rhodesia do not show any cause for alarm. The death rate still remains in the neighbourhood of 10 per cent. This is due very largely to our ideal climate for poultry but in no small measure to the careful management of birds generally. During the last few years the tendency has been towards a lower mortality.

On this test 15 birds succumbed; about 8 per cent. of all birds. Of these 10 were due to various ovarian disorders usually resulting in Peritonitis. Two were due to rupture of the Hepatic Artery. One each due to Pneumonia, Sarcoma and Enteritis.

Ovarian disorders may be expected in highly developed stock many of which undoubtedly arise from transport and from the necessary handling when despatching and receiving birds.

It is one of our greatest aims to keep up the health and stamina of our stock which at present is so high for the conditions prevailing in other countries are a continual warning of what may be expected if any diminution in the robust health of our stock takes place.

Mortality Table.—The following Table shows the mortality of the birds at the Laying Tests to date.

Year	No. of Birds	No. of Deaths	Percentage of Deaths
1926-27	100	13	13 per cent.
1927-28	100	14	14 per cent.
1928-29	100	8	8 per cent.
1929-30	100	15	15 per cent.
1930-31	200	19	9.5 per cent.
1931-32	200	24	12 per cent.
1932-33	138	20	14 per cent.
1933-34	100	15	15 per cent.
1934-35	100	8	8 per cent.
1935-36	138	10	7 per cent.
1936-37	180	15	8 per cent.

The 52 Week Test.—As several birds had put up such good records at the conclusion of the 48 week test those capable of reaching a record of 300 eggs were held over for the full period of 52 weeks.

It is a pleasure to record that three birds completed the 365 day period with records of over 300 2oz. eggs. This is the first time an official record of 300 egg birds has been made in Rhodesia and the owners are to be congratulated.

The birds were as follows:—

(1) Bird 27.—Rhode Island Red owned by Miss Higginson, Wendiri, M'Sonneddi, Southern Rhodesia, laid 315 2 oz. eggs and 3 under 2 oz. eggs.

(2) Bird 21.—Rhode Island Red owned by Miss Higginson, laid 306 2 oz. and 2 under 2 oz. eggs.

(3) Bird 152.—Australorp owned by R. Raynor, Esq., Nicotina, Darwendale, Southern Rhodesia, laid 301 2 oz. eggs.

It is hoped that future tests under the new rules will be as popular and do as much for the Industry as undoubtedly has been done by the tests until now, especially in improving the size of egg laid by our strains of poultry which are now as good in this respect as any to be found elsewhere.

The test commences annually on March 1st and terminates on January 30th. Entries close on January 15th. All interested are asked to communicate with the Poultry Officer, Department of Agriculture, P.O. Box 387, Salisbury.

The following are the final awards and results of the Pen and Single Bird Competition also the Winter Test:

AWARDS.

1.—*Special Award Certificates for the three leading pens for the duration of the Contest.*

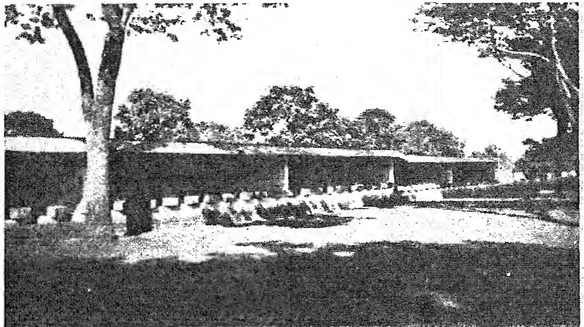
HEAVY BREED SECTION.

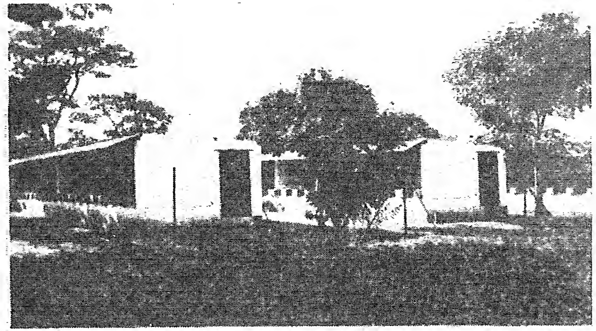
		2oz. & over.	lbs.	oz.	Under 2oz.	lbs.	oz.
1st —Pen 6, Miss V. Higginson, M'Sonneddi.	Rhode Island Reds	1,077	144	15 9/16	108	12	9 12/16
2nd—Pen 1, Dan Jacobs, Germiston.	Australorps	970	143	0 15/16	3	—	4 13/16
3rd—Pen 5, Miss V. Higginson, M'Sonneddi.	Rhode Island Reds	1,023	135	12 4/16	194	22	11 9/16

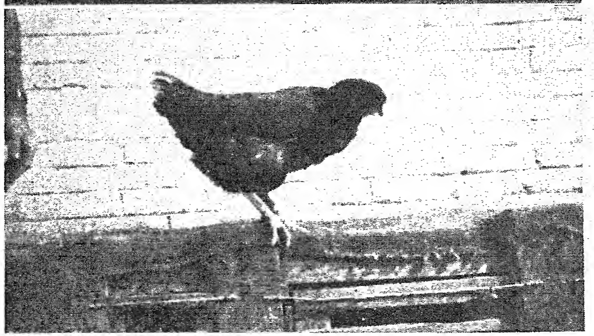
LIGHT BREED SECTOIN.

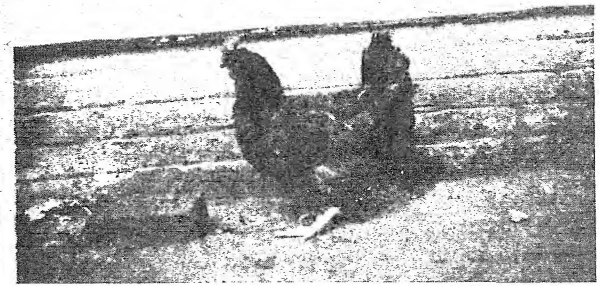
1st —Pen 17, D. Jarvis, Gwelo.	White Leghorns	1,087	150	4 14/16	42	4	13 5/16
2nd—Pen 23, W. A. Bull, P.B. Umtali.	White Leghorns	1,075	150	1 14/16	14	1	8 3/16
3rd—Pen 18, E. E. C. Green, Bulawayo.	White Leghorns	1,064	150	1 3/16	66	7	12 10/16

THE FIRST OFFICIALLY TESTED 300 EGG HENS IN RHODESIA.









(1) Single Pen accommodation at the Government Poultry Station, Salisbury, Southern Rhodesia.

(2) Single Pens end view.

(3) Rhode Island Red, No. 27, owned and bred by Miss Higginson, Wendiri, M'Sonneddi, S. Rhodesia.
Record: 315 2 oz. and 3 under 2 oz. eggs in 365 days.

(4) Australorp, No. 152, owned and bred by Captain R. Raynor, Darwendale, S. Rhodesia.
Record: 301 2 oz. eggs in 365 days.

BLUE RIBBONS:

Embossed Blue Ribbons will be awarded to the Hen in each Section with the highest record of 2 oz. eggs and over and has a record of not less than 250 2oz. eggs in 48 weeks.

Hen No.	Pen	No. of Eggs.	Name and Address.	Breed.
27	6	292	Miss V. Higginson, Wendiri, M'Sonneddi.	Rhode Island Red
130	26	255	E. Hallauer, Esq., P.O. Box 681, Bulawayo.	White Leghorn

FIRST CLASS Pen Certificates. To Pens averaging 220 2oz. eggs.

HEAVY AND LIGHT BREED SECTIONS.

Nil.

SECOND CLASS Pen Certificates. To Pens averaging 200 2 oz. eggs.

HEAVY BREED SECTION.

Pen 6, Miss V. Higginson, Wendiri, M'Sonneddi. — Rhode Island Reds laid 1001 2 oz. eggs.

LIGHT BREED SECTION.

Pen 18, E. E. C. Green, Esq., P.O. Box 879, Bulawayo. — White Leghorns laid 1017 2 oz. eggs.

Pen 17, D. Jarvis, Esq., P.O. Box 14, Gwelo. — White Leghorns laid 1004 2 oz. eggs.

INDIVIDUAL HEN CERTIFICATES.

FIRST CLASS Certificates to Hens laying 240 2 oz. eggs.

Hen No.	Pen	No. of Eggs.	Name and Address.	Breed.
21	5	283	Miss V. Higginson, Wediri, M'Sonneddi.	Rhode Island Red
152	—	280	R. Raynor, Esq., Nicotina, Darwendale.	Australorp
155	—	261	Miss V. Higginson, Wendiri, M'Sonneddi.	Rhode Island Red
28	6	256	Miss V. Higginson, Wendiri, M'Sonneddi.	Rhode Island Red
2	1	255	Dan Jacobs, Esq., Webber, Germiston.	Australorp
151	—	244	Dan Jacobs, Esq., Electric Poultry Farm, Webber, Germiston.	Australorp
154	—	244	H. Scully, Esq., Windyridge Poultry Farm, Bellevue, Bulawayo.	Australorp
1	1	240	Dan Jacobs, Esq., Electric Poultry Farm, Webber, Germiston.	Australorp
113	23	248	W. A. Bull, Esq., Fairholme Poultry Farm, P.B. P.1, Umtali.	White Leghorn
124	25	246	R. Raynor, Esq., Nicotina, Darwendale.	White Leghorn

Hen No.	Pen	No. of Eggs.	Name and Address.	Breed.
173	—	244	W. A. Bull, Esq., Fairholme Poultry Farm, P.B. P.1, Umtali.	White Leghorn
96	20	240	Capt. A. G. Waller, P.O. Box 823, Salisbury.	White Leghorn
160	—	253	A. V. Johnson, Esq., P.O. Box 238, Salisbury.	Black Leghorn
111	23	253	W. A. Bull, Esq., P.B. P.1, Umtali.	White Leghorn

SECOND CLASS Certificates to Hens laying 220 2 oz. eggs.

Hen No.	Pen	No. of Eggs.	Name and Address.	Breed.
39	8	236	R. Raynor, Esq., Nicotina, Darwendale.	Rhode Island Red
14	3	229	Roodewal Poultry Farm Louis Trichardt.	Australorp
17	4	224	H. Scully, Esq., Windyridge Poultry Farm, Bellevue, Bulawayo.	Australorp
85	17	239	D. Jarvis, Esq., P.O. Box 14, Gwelo.	White Leghorn
81	17	236	D. Jarvis, Esq., P.O. Box 14, Gwelo.	White Leghorn
123	25	235	R. Raynor, Esq., Nicotina, Darwendale.	White Leghorn
58	12	232	Dan Jacobs, Esq., Electric Poultry Farm, Webber, Germiston.	White Leghorn

No. Hen	Pen	Eggs. No. of	Name and Address.	Breed.
165	—	229	Maramba Poultry Farm, P.O. Box 121, Livingstone.	White Leghorn
116	24	228	W. A. Bull, Esq., Fairholme Poultry Farm, P.B. P.1, Umtali.	White Leghorn
175	—	228	R. Raynor, Esq., Nicotina, Darwendale.	White Leghorn
139	28	227	F. C. Brock, Esq., P.O. Box 10, Bindura.	White Leghorn
72	15	225	Maramba Poultry Farm, P.O. Box 121, Livingstone.	White Leghorn
103	21	222	Capt. A. G. Waller, P.O. Box 823, Salisbury.	White Leghorn
112	23	222	W. A. Bull, Esq., Fairholme Poultry Farm, P.B. P.1, Umtali.	White Leghorn
64	13	221	Mrs. M. C. Bragge, Hillside, Bulawayo.	White Leghorn
88	18	221	E. E. C. Green, Esq., P.O. Box 879, Bulawayo.	White Leghorn
147	30	221	E. J. Speed, Esq., P.O. Box 41, Selukwe.	White Leghorn
163	—	221	Mrs. M. C. Bragge, Hillside, Bulawayo.	White Leghorn
170	—	220	Capt. A. G. Waller, P.O. Box 823, Salisbury.	White Leghorn

AWARDS.

For the three leading pens for the duration of the Winter Test in each section.

HEAVY BREED SECTION.

		2oz. & over.	lbs.	oz.	Under 2oz.	lbs.	oz.
1st —Pen 6, Miss V. Higginson, M'Sonneddi.	Rhode Island Reds	421	56	0 4/16	32	3	10 15/16
2nd—Pen 7, Ardenlee Poultry Farm, Nottingham Road.	Rhode Island Reds	373	51	11 1/16	5	—	8 9/16
3rd—Pen 5, Miss V. Higginson, M'Sonneddi.	Rhode Island Reds	401	51	5 12/16	58	6	11 7/16

LIGHT BREED SECTION.

1st —Pen 25, R. Raynor, Esq., Darwendale.	White Leghorns	342	45	9 11/16	12	1	6 3/16
2nd—Pen 23, W. A. Bull, Esq., P.B. Umtali.	White Leghorns	333	44	9 8/16	10	1	0 10/16
3rd—Pen 28, F. C. Brock, Esq., Bindura.	White Leghorns	308	41	12 15/16	20	2	5 6/16

AWARDS.

To the three leading birds for the duration of the Winter Test in each Section of the Single Bird Competition.

			2oz. & over.	lbs.	oz.	Under 2oz.	lbs.	oz.
HEAVY BREED SECTION.								
Bird 152—1st	R. Raynor, Esq, Darwendale.	Australorp	99	13	14 12/16			
Bird 157—2nd	Ardenlee Poultry Farm, Nottingham Road.	Rhode Island Red	86	13	2 15/16			
Bird 151—3rd	Dan Jacobs, Esq., Germiston.	Australorp	84	11	10 7/16			
LIGHT BREED SECTION.								
Bird 160—1st	A. V. Johnson, Esq., Salisbury.	Black Leghorn	93	14	7 11/16			
Bird 171—2nd	Capt. A. G. Waller, Salisbury.	White Leghorn	88	10	11 8/16	6		11 4/16
Bird 175—3rd	R. Raynor, Esq., Darwendale.	White Leghorn	78	10	10 8/16			

AWARDS.

To the three leading birds in the "Single Bird" section for the duration of the Test.

HEAVY BREED SECTION.

			2oz. & over.	lbs.	oz.	Under 2oz.	lbs.	oz.
Bird 152—1st	R. Raynor, Esq., Darwendale.	Australorp	280	41	12 6/16			
Bird 155—2nd	Miss V. Higginson, M'Sonneddi.	Rhode Island Red	266	35	11 7/16	3		5 10/16
Bird 154—3rd	H. Scully, Esq., Bellevue, Bulawayo.	Australorp	247	35	7 10/16	2		2 14/16

LIGHT BREED SECTION.

			2oz. & over.	lbs.	oz.	Under 2oz.	lbs.	oz.
Bird 160—1st	A. V. Johnson, Esq., Salisbury.	Black Leghorn	253	39	10 1/16			
Bird 173—2nd	W. A. Bull, Esq., P.B. Umtali.	White Leghorn	246	34	12 1/16	2		3 8/16
Bird 175—3rd	R. Raynor, Esq., Darwendale.	White Leghorn	236	33	8 14/16			

The Rhodesian Home Orchard.

By G. W. MARSHALL, Horticulturist.

(Continued.)

Treatment of Trees on Arrival.—On arrival of the trees from the nursery they should be placed in a shady spot and kept moist until planted. They should not be left for any length of time in the boxes or sacking in which they were packed, but should be heeled into a trench and kept there until wanted. The heeling-in process consists of digging a trench about 18 ins. in depth, with one side sloping at an angle of about 45°. The trees are laid in at this angle not more than two deep, the soil being well worked around the roots and the trench then being filled with soil and watered occasionally to keep the trees in good order.

Trees received from a good distance sometimes arrive in a withered condition; these should be completely immersed in fresh water (running water if possible) for at least twelve hours or until the withered stems and branches regain turgidity. The revived trees may then be heeled-in as previously described, or planted if planting preparations have been completed.

Planting.—Before planting is commenced it is well to be sure that all the necessary appliances are at hand. These are: Marking board (previously used when double pegging), spade, sacking to protect the tree roots, secateurs (pruning shears) to trim the tree roots and tops, Bordeaux paste and brush to colour-wash the tree stems, and a sufficient supply of water to water the trees when planted.

Everything being in readiness, a few trees are then taken from the heeling-in trench, the roots being wrapped in damp sacking. Proceed to the first filled-in hole and have a small hole dug between the two pegs, then place the marker board end notches against the two pegs. Take a tree from the damp sacking and cut out the broken, twisted, damaged or diseased roots, and shorten back those that are too long. All cuts should be made diagonally on the under side of the roots. Care should be exercised that the roots are not at any time during the planting unduly exposed to sun or wind; cool and overcast days are best for planting, but these favourable conditions are not always to be had.

The stem of the tree is now placed in the central notch of the marked board, with the upper roots almost touching the planting board; the soil is then filled in slowly, the roots being evenly spread in all directions and well covered. Now remove the marker board and shake the tree slightly with an up and down action; this will assist the finer soil particles to collect round the roots and fill in the air spaces. A slight mound should be made over the roots at the base of the tree, after which the soil should be firmed by tramping it well over the roots and up to the stem. No fruit tree should be planted too deeply; plant no deeper than it stood in the nursery. This depth will be indicated by the nursery mark (junction of the yellow and brown or green bark of the stem near the roots).

It is an advantage to keep the nursery mark 2 ins. to 3 ins. above the normal soil level: the tree will then be well planted, and as the soil subsides the tree will gradually sink to the nursery mark level. If the upper roots of the newly-set tree are very close to the soil surface a small mound of loose soil may be placed over them; this will prevent any over-heating or undue drying of the soil surrounding the shallow roots. The mound will gradually disappear with cultivation, but not before the tree is well rooted and no longer requires this additional protection. After planting, cut the tree back as illustrated for deciduous trees. Single stem trees may be

headed back to the knee high for deciduous and 30 ins. for citrus trees. Nursery shaped trees should have from three to four main arms retained for most deciduous fruits, with the exception of plum trees, which may have as many as six arms retained. The heading back of the tree will enable the reduced root system (lost when lifting in the nursery) to feed the proportionately reduced top in a normal manner.

Many fruit trees are planted without cutting back the tops; this is wrong, and causes an undue demand on the root system, of which over half was left in the nursery at the time of lifting. The larger the tree, the greater the loss of roots at the time of lifting. To counteract the loss of roots a proportional amount of the top must be cut away at planting. The trees should be watered as they are planted with at least eight gallons of water to each tree, and more if the soil is very dry. The watering will settle the soil and at the same time supply the tree with the necessary moisture with which to revive growth. When the surface of the soil is sufficiently dry after watering it may be lightly loosened again to check evaporation.

Protection from Sun-Scald.—It is advisable to protect the stems of all newly-planted trees from the hot sun; some growers use grass, but this is dangerous where ants are prevalent. The best temporary method of protection is to colourwash the stems with Bordeaux mixture mixed to the consistency of thin cream.

A flat wooden slat of about 3 ins. in width is also useful for this purpose; it should be fixed on the western side of the tree stem. The sun's rays are then unable to shine directly on the tender stem and cause sun-scald. Attach the slat to the tree with string or spiral wire, care being exercised that the binder does not damage the bark of the tree by cutting into it. Trees damaged by sun-scald or those with a tendency to sun-scald should be slit through the bark from the ground level to the top of the main stem, also the main arms—always, however, on the western side; this allows the tree to develop naturally, unslit trees are apt to become bark-bound, which dwarfs the trees and affects their productiveness. They are also more susceptible to disease attack.

Where Fruit is Produced on Different Varieties.

Apple and Pear.—On spurs chiefly, also from terminal and lateral buds. Always on wood of the previous season's growth.

Quince. — From co-terminal buds on wood of the current season's growth.

Peach, Nectarine and Almond. — On wood of the previous season's growth.

Apricots and Plums.—Generally on fruit twigs and shoots produced during the previous season's growth.

Figs.—First crop, previous season's wood, second crop, on current season's wood.

Citrus.—On current season's growth; main crop of fruit on spring growth.

Walnut and Pecan Nut.—On current season's growth.

Mango and Loquat. From terminal buds of previous season's growth.

Most other Tropical and Sub-tropical Fruits. On wood of the current season's growth.

Grape Vines.—On new season's growth.

Most fruit buds are easily distinguished from leaf or shoot buds by their plumper appearance. With a moderate amount of experience it is possible to forecast the next fruit crop from the current season's fruit—bud formation.

When the bearing habits of the different kinds of fruit trees are understood it is possible for the fruit grower to regulate by pruning the bearing of each individual tree, and thereby overcome to a great extent the necessity for fruit-thinning after the crop has set.

Pruning.—The theory of pruning is based on certain observed facts, and the ultimate objects are:—

(*a*) To produce a tree of a desirable shape.

(*b*) To permit of economical cultural operations.

(*c*) To reduce or stimulate the production of wood or fruit-bearing growth, as the circumstances require.

(*d*) To remove injured, diseased or worn-out growths.

To accomplish these the farmer must take into consideration rules or laws which appear to almost invariably operate in the growth of plants; those of primary importance may be set out as follows:—

(1) The vigour of a tree is dependent upon its leaf surface.

Considering that the leaves are practically the lungs and stomach of the tree, this statement is tantamount to saying that the plant which has the largest transpiring and assimilating capacity must, when food is unlimited, be the strongest grower. This law has an important bearing on all pruning operations whilst the tree is in a state of vegetative activity.

(2) The nearer a shoot approaches a vertical position the stronger will be its growth. This is founded on an unvarying law of nature, by virtue of which the sap of plants flows more freely to the highest point of each shoot.

(3) The nearer a shoot approaches a horizontal position, so does its vigour diminish.

This is only a natural corollary to the previous statement. These two rules have a most important bearing up on the selection of shoots required for wood or fruit production. Vertical shoots usually run to wood above, while those tending towards a horizontal plane turn to fruitage. This goes to show that fruit bearing is an attribute of moderate weakness rather than of great vigour.

(4) The lesser the number of buds upon a branch the stronger will be the growth made by each individual shoot arising therefrom.

This may be put in other words, namely, that heavy pruning of the top tends to increase the production of strong wood growth. Under normal conditions of growth there is a balance between root and top. They mutually nourish each other, but when suddenly the top is reduced, without the inference of disease, the remaining buds make haste to utilise the extra volume of sap sent up to them. Partly for this reason, when pruning newly set trees, the number of buds is reduced by pruning away a large portion of the top shoots.

(5) If the root system be reduced the vigour of the top growth will be correspondingly diminished.

It is this fact which causes orchardists to prune the roots of rank growing unfruitful trees. Again, when young trees are removed from the nursery, many roots are cut off or so damaged as to necessitate their amputation. To counteract this the top growth must be curtailed, otherwise stunted development or death may result.

(6) When a number of shoots are growing at different levels upon the same tree, generally the topmost shoot absorbs most sap and outgrows those below.

This is seen in every tree, and gives rise to the practice of pinching the growing tips out of the highest shoots on young trees so as to lessen their natural advantage.

(7) Deformations of any kind, such as those produced by wounds or compression of sap vessels, diminish the activity of those parts situated above them.

The correctness of this statement is clearly shown in the effects produced by bruises, large wound scars, partial fractures, or the hardening of the bark caused by sun-scald.

(8) Within certain limits, the fruit production of any plant or tree diminishes with the increased development of its vegetative growth.

In other words, when a mature tree is forced into making vigorous growth, its production of fruit is lessened. Again, young trees, when properly nourished and trained, do not fruit freely until they have assumed considerable dimensions and have branches usually growing in a lateral direction, which make weak growth. This also points to the fact that the fruit-bearing habit arises from a quiescent condition in the plant or branch. To quote an extreme case, a superabundant crop of oranges is usually regarded as a sign of the tree having begun to decline.

(9) The smaller the number of fruits the better their quality and size.

This is the chief reason why fruit growers thin their crops at an early stage of development. Pruning also is utilised to the same end. By judicious thining out of the fruiting wood the possible number of fruits is lessened, and each one retained receives a larger share of the plant food elaborated.

The Seasons for Pruning.—Winter Pruning.—Winter pruning, which is practised when the wood has ripened and the leaves have fallen from deciduous trees, is most important. When the tree is devoid of foliage, the pruner can see the position of each branch and weight its present use or calculate its future value.

The general effect of winter pruning is to stimulate vigorous growth when the growing season again begins. Winter pruning may be calculated to ensure wood growth for subsequent fruit crops rather than actual fruit production. It is of the greatest value in shaping young trees or renovating older trees which lack vigour.

The objects of winter pruning may be summarised as follows:—

1. To regulate the shape of young trees.
2. To ensure fruit wood formation on mature trees.
3. To regulate the fruit crop by the judicious cutting out of unnecessary fruiting wood.

Summer Pruning.—Summer pruning is the term used to define those operations which are performed upon a tree while in active growth. The objects are:—

(*a*) To suppress all undesirable growths when they first appear.

(*b*) To admit sufficient air and sunlight to the innermost branches, thus permitting them to mature naturally.

The suppression of all undesirable growths should be performed during the early part of the growing season. Other summer pruning is best performed in the latter half of summer or when there is no danger of the trees making new growth to replace the shoots taken out.

The Desirable Tree.—The ideal shape of a mature deciduous fruit tree is that of a goblet or wine glass, that is to say the tree has a straight, short stem from which arise the main and secondary arms, while the centre is moderately open.

Proper Pruning.—First Year at Planting.—As previously stated, young trees should be headed back at planting time, knee high for unshaped deciduous trees and 30 inches for

citrus trees. When heading back at planting time, it is often found that a good framework has been produced in the nursery. If the branches arise on the main stem at the desired distance from the ground (18 inches deciduous, 30 inches citrus), select from three to six well spaced shoots arising from different points on the main stem and cut out the rest. The shoots retained should then be shortened back to about 9 inches in length or in proportion to their development (6 inches for weak to 12 inches for very strong). Three to four main arms are sufficient for most fruit trees. Plums with advantage may have up to six. The heading back of the main arms should be done in such a manner as to have all the cuts about level; if uneven, the highest one will outgrow the rest and produce a one-sided tree. When viewing a recently headed back tree from above, the cut surfaces of the three-armed tree should form a triangle, if four a square, and if six a hexagon.

Summer Treatment.—The first growth that takes place after planting, if correctly treated, will soon form a well-shaped tree. Two shoots should not be allowed to develop from one spot. The weaker shoot should be rubbed off when still young and tender. If double shoots are allowed to develop from one spot on the main stem or main arms of a tree, they will form a Y crotch, which is objectionable owing to the likelihood of the crotch splitting with the weight of the fruit when the tree commences to bear.

All those shoots that have a tendency to cross or crowd each other should be suppressed. The energy required to produce these unnecessary shoots will then be deviated to the desired ones, which in turn will grow more vigorously. Shoots having a tendency to outgrow the rest should have their tips pinched back; this check generally has the desired effect of balancing the new growth. If the heads of the young trees are inclined to become too dense, it is advisable to thin out some of the growth. Air and light are essential for good healthy development. All shoots arising on the main stem should also be rubbed off as they appear; neglect in this respect will result in multi-stemmed and mis-shaped trees.

In training during the growing season the aim should be to encourage at least two good shoots to develop from each

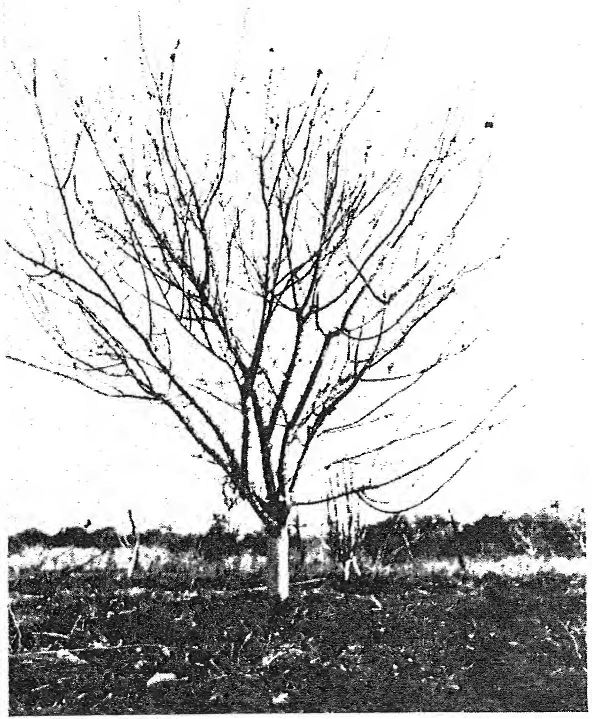
main arm, one from either side. Trees with three main arms will then have six secondary arms, those with four will have eight, and so on.

Second Year's Winter Treatment.—If the trees have been well shaped during their first year's growth there is very little to be done during the second year's winter pruning when the leaves have fallen. All that is necessary is to cut any badly shaped, diseased or crowded shoots that may have been overlooked during the previous summer treatment. In trees with a natural spreading habit (apricot), the erect growing shoots should be retained for the secondary arms or leaders (see Fig. 5, parts of a tree, for explanation of these terms). With erect growing trees (Wickson plum), retain shoots to form the leaders from those with an outward growing tendency. Adopt long pruning for best results; this means the non-cutting or shortening back of the retained fruiting or other wood. All shoots that are removed should be cut off close up to the limbs that form the framework of the tree; stubs are objectionable, as they may either produce an abundance of unnecessary growth or die back and so impair the health of the tree.

In all pruning operations care should be exercised not to injure the tree unnecessarily. Use good and sharp pruning tools, and see that all cuts exceeding ½ inch in diameter are coated with a suitable oil paint: this prevents water from entering the wound, also decay.

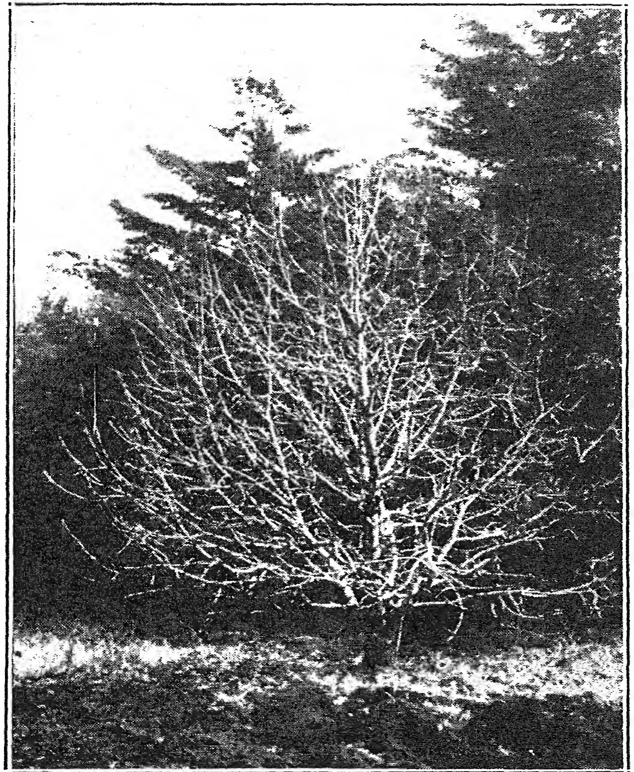
Second Year's Summer Treatment.—This is similar to the summer treatment previously mentioned, comprising rubbing off all undesirable double growths, suckers and shoots that have a tendency to cross or crowd each other.

Early maturing varieties such as plums may have their strong lateral shoots broken back, but not detached, to about one-half their length. This breaking back should be done about January or sufficiently early in the growing season to enable the lower half of the treated shoot to form fruit-producing wood. This treatment, too, is recommended for large trees in vigorous growth. In many cases apple trees, if left to themselves, will have a tendency to produce one or more long shoots. When this occurs these shoots should be pinched back when about 9 inches in length to induce branching.

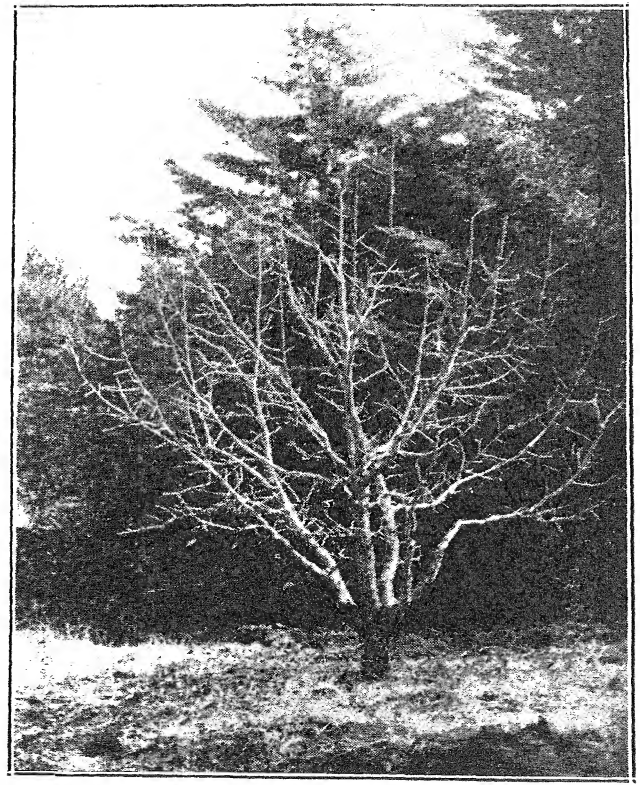


Stone Fruit Tree before pruning.

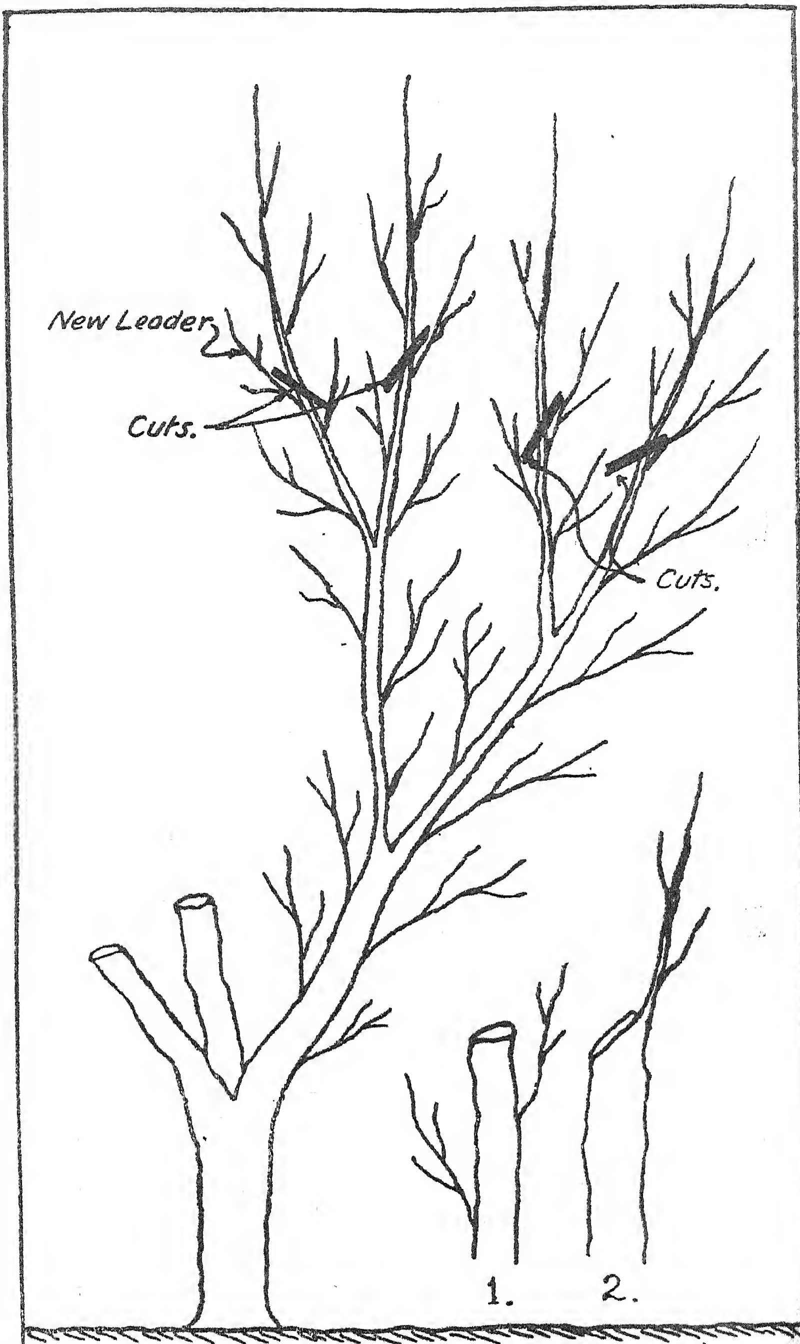
Same Tree after being pruned.



Old and neglected pear tree before pruning.

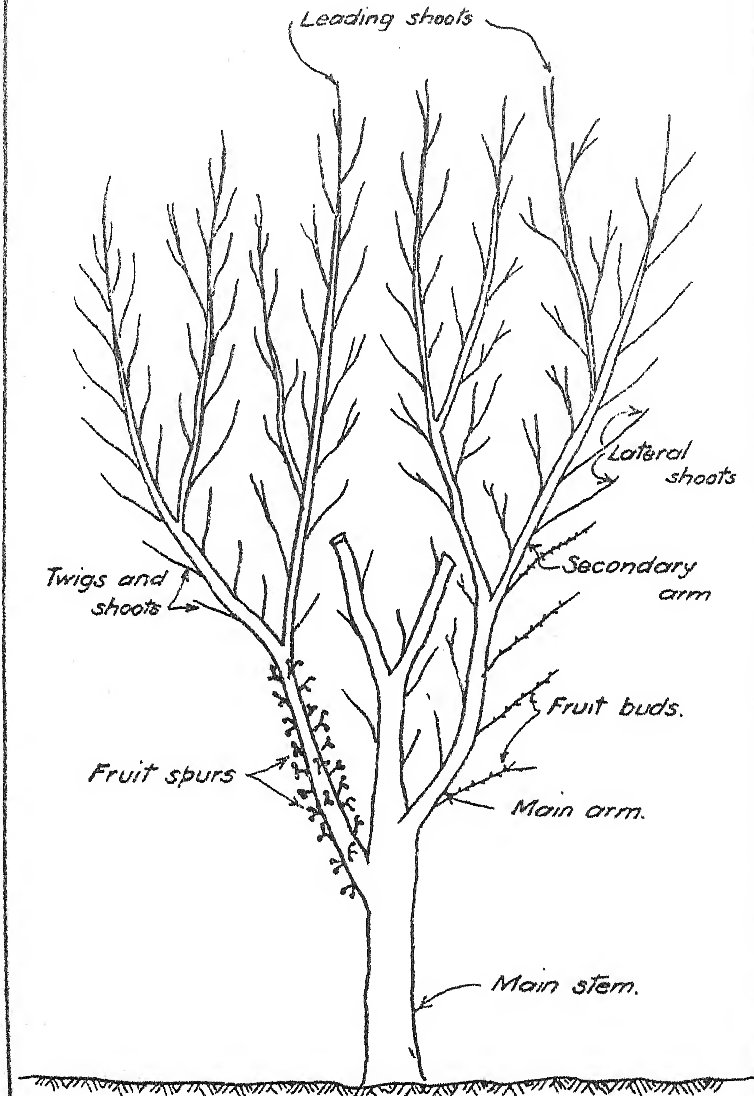


Same tree after pruning.



How to cut when heading back a tall Tree

1., A bad cut. 2., A good cut.



Parts of the Tree

Third and Subsequent Year's Treatment.—From now on the aim is to prune for fruit. If long pruning is adopted, summer pruning will be found to be of the greatest importance, as it will enable the grower to suppress at the correct time all unnecessary growths, and by the breaking of strong laterals induce good fruiting wood to form where is it wanted.

The winter treatment should then be confined to the cutting off of the broken points of the summer treated laterals, fruiting wood where crowded should be thinned, and leading shoots that grow too high should be shortened. When heading back a tall tree, select an outward growing lateral that arises some distance below the tip of the leader (see Fig. 6), and cut off just above the one selected. This system of heading back tall growing trees eliminates the possibility of a dense top growth occurring, as would be the case if other heading back methods were practised.

In a tropical climate and with the sun directly overhead in summer, it is not advisable to have the trees too open in the centre. To serve as a reasonable protection from sunburn, a few small branches should be left to develop from the secondary arms: these should grow inwardly, but should not be too dense. When deciduous fruit trees are left unpruned they have a tendency to bear heavy crops of small fruit every alternate season and little or no fruit in between. This is due to the trees being weakened through lack of proper care and nourishment, and they are consequently unable to mature a crop of fruit and fruiting wood for the succeeding year, as is done in healthy and well pruned trees.

Root Pruning.—Large fruit trees that bear no fruit but grow profusely should be root pruned; this will reduce the tree's vegetative activity and induce fruitfulness.

Root pruning is done by digging a trench round the tree, usually equal to the spread of the branches and about 2 to 3 feet deep. All roots that cross the trench are cut off, and the trench should then be refilled with the soil previously taken out. This treatment is generally effective, but this class of unfruitfulness must not be confused with that due to lack of inter-pollination.

Unprofitable Trees.—Many fruit trees on reaching maturity may be found to be unprofitable; the trees may either produce inferior fruit or poor crops. They should be rooted out or re-grafted to suitable varieties.

Some fruit trees, if old, seldom give satisfactory results when top-worked, and should be replaced with young trees. Apple and pear trees may be top grafted to some known good variety.

Trees Fruiting too Young.—Early fruiting should not be encouraged on young trees, as it is apt to dwarf or affect them to such an extent that they may be of little or no value in later years. It should be the aim of every owner to encourage top growth, and to achieve this all fruit must be stripped from the trees as it sets, thereby enabling them to utilise all of their energy for the development of the frame and fruiting wood of the tree.

No hard and fast rule may be laid down for the age at which trees should bear their first crop of fruit; this is dependent on many factors, but for the guidance of those unaccustomed to working with fruit trees it may be as well to give the average bearing age of a few of the more important fruits. These are:—

Citrus Fruits.—These often set a small crop of fruit within a year of planting, but they should not be permitted to bear before the third season, and in some cases, when the tree has made a poor growth, not before the fifth season.

Stone Fruits (Peach, Plum, Apricot, Almond, Nectarine, etc.).—If the trees make good growth during the first season they may be permitted to carry a little fruit during the second year. The third year, however, is the correct time for them to commence fruiting.

Pomaceous Fuits (Pear, Apple, Quince, etc.).—A very wide range of bearing ages is to be found in this group. Some varieties may commence bearing the second or third year after planting: others not for ten or more years. A fair average may then be taken at five years, but on no account should any trees in this group be permitted to bear before the third season, and then only one or two speciment fruits per tree.

Other Fruits.—Guava and paw-paw, second year; fig, mulberry, custard apple and mango, third year: avacado pear (seedling), seventh to tenth year, budded third to fifth year.

Fruit Thinning.—Many fruit trees, although well pruned and cared for, may have a tendency to produce more fruit than they are capable of maturing, the resultant crop often being very small and unsuitable for the home requirements.

All trees should be examined a few weeks after blossoming, and those that set too heavy a crop should have the fruit thinned out to enable the tree to safely carry the load and at the same time produce good sized fruit.

By thinning a fruit crop it is often found that it is possible to produce an equal weight of good large fruit from a tree that has been correctly thinned as would have been the case had the whole crop of fruit been retained. To obtain the best results fruit thinning should be carried out when the fruit is still small, as late thinning is unsatisfactory. Every owner must use his own discretion when thinning fruit, as he will be the only one capable of gauging the fruit-carrying capabilities of his trees.

To assist those undertaking this operation for the first time it may be advisable to lay down a few rules to be observed when thinning, namely:—

(*a*) When fruit is borne in clusters it is advisable in most cases to reduce the clusters to three fruits.

(*b*) Fruits borne along the entire length of lateral shoots: these should be thinned down to one to four fruits, or in accordance with the vigour or length of the shoot.

Harvesting and Storing.—All fruit should be carefully gathered and placed in padded baskets or boxes. It should be handled much in the same way as eggs, for all bruised fruit will have its keeping quality impaired. A ladder should be used when necessary; do not pull the branches down, they may be broken, and if this happens the shape of the tree may be ruined. Many years' work is necessary to re-shape broken trees.

Some fruits ripen better when stored in the house or store. These varieties if left to ripen on the tree produce fruit of an inferior quality, mealy and unpalatable. Wickson plums and most apples and pears must be gathered before ripe if the best flavoured fruit is wanted. When harvesting pomaceous fruits such as pears, apples, etc., it is extremely important that the fruit be neither too green nor too ripe, but there are a few exceptions to this rule. An excellent test, although not always dependable, to ascertain the correct stage for harvesting the pear in particular is one in which the fully developed fruit is gently lifted upward. If the fruit stalk detaches from the twig or shoot easily, the fruit is ready to harvest. A safer test for the amateur is one where the fruit is cut through the centre horizontally to expose the seed cavities. If the seed is commencing to turn brown the fruit it fit to harvest. But some apple and pear varieties may be found to have brown seeds before the fruit is quite fit to harvest, and here a little experience in picking is necessary.

When harvesting fruit the picker must always aim at the retention of the stem or stalk. Fruit from which the stalk has become detached will decay or wilt more readily, and the keeping properties are considerably impaired. Fruit that does not detach easily must be clipped in the same manner as is done when harvesting citrus fruits.

Harvesting should continue from time to time as the fruit sizes up and is at the correct stage of ripeness. It may sometimes be necessary to pick over a tree several times. Harvesting should take place when possible during the cool period of the day. If carefully handled at harvesting, many varieties of fruits may be stored for several weeks. The fruit may be spread out on shelves or packed in single layers in clean boxes. These may then be stacked one on the other. When storage is contemplated it is as well first to test the keeping qualities as the different varieties ripen, and to do this it is advisable to pick a little fruit at different stages of ripeness. This will soon furnish the desired information regarding keeping quality and the best stage of ripeness at which to harvest. Immature fruit will generally shrivel and over-ripe fruit become mealy. The correct stage will give good coloured and well flavoured fruit.

Irrigation.—If water is available, trees should never be allowed to suffer for want of it. All trees require water in early spring before blossoming, and citrus trees again when in full blossom.

Irrigate whenever the soil lacks moisture or when the tree leaves are inclined to feel limp (not turgid) when felt in the early morning.

The absence of sufficient moisture soon affects the turgidity of the leaf and is easily detected about breakfast time. If trees have sufficient moisture the leaves will be crisp. Too much water is just as harmful as too little; trees so treated are more susceptible to disease, fruit is inferior in quality and lacks keeping qualities. Never allow water to come in direct contact with the stems of trees nor apply cold water to fruit trees such as the fig when the soil is hot. This may cause shedding of the immature fruit.

Small and frequent applications of water should not be given; this induces shallow rooting, while most of the added moisture is lost by evaporation. Rather supply water in much larger quantities and at intervals of one month to six weeks, and loosening the surface soil after the water has soaked away.

Manuring.—All fruit trees should be manured and fertilised from the time they start bearing fruit. Farmyard or kraal manure is the best, for it not only supplies necessary plant foods, but a large amount of humus. This organic matter improves the physical condition of the soil, and is in every way desirable. Necessary soil bacteria are able to increase and liberate other plant foods. If manure is unavailable, green crops must be planted, and these, when grown, should be ploughed or dug in. Leguminous crops, such as beans, peas, sunn hemp, etc., are best: they absorb nitrogen from the air and fix it in the soil through the agency of bacteria present on their roots.

All weeds that are cut out from time to time should be saved, and at the end of the rainy season spread out and ploughed in along with the green crop. In addition to green cropping, artificial fertilisers are sometimes advisable, the quantity to apply varying with the nature and fertility of the soil. There is also the age or variety of tree to consider.

Complete fertilisers are as a rule the best, for they contain all the essential plant foods. As a basis to work on, well grown fruit trees should receive 100 lbs. of kraal manure per tree per annum; also a complete commercial fertiliser containing 16 per cent. phosphoric oxide, 6 per cent. nitrogen and 15 per cent. potash. This commercial fertiliser, known as fruit and citrus fertiliser may be applied at the rate of 1 lb. for each year of tree's age, with a maximum of about 10 lbs. for deciduous and 15 lbs. for full grown citrus and other evergreen fruit trees.

The most convenient time to apply the manure and fertiliser is at the end of the rainy season or when the soil is in good condition for ploughing it in. All manures and fertilisers should be broadcast between the trees (not under them). This applies to well grown trees which have their root systems well distributed throughout the soil. For young trees the applications may be made nearer the trees, but not nearer than one foot from their stems.

Cultivation.—All work connected with fruit growing must be carried out systematically, and a definite programme should be laid down and rigidly adhered to. Every detail of working is an important item and must be attended to at the correct season. There is a right time for all orchard work, and if this opportunity is once missed it is liable to be reflected in the next season's crop, and even for longer periods.

It is, unfortunately, a not infrequent occurence for the orchardist to defer working up the land immediately after the rains have ceased. Thus when the delayed work is eventually carried out a good tilth is not obtained. Incalculable harm may be done to fruit trees by delaying the autumn digging or ploughing until so late that the ground has become too dry for effective tillage, and much of the soil moisture has been lost. On the heavier soils, too, the earth breaks up into huge clods, and it may then take more than a whole season to bring back a good tilth to the orchard.

Instances could be quoted where such delays have occurred in cultural operations, with the result that the crops of fruit then maturing were impaired, and the crops set a few months later were greatly reduced. Delay in carrying out

the necessary cultural operations usually spells loss of crop, and these remarks apply not only to cultivation, but to all other phases of orchard work.

Cultivation is beneficial and necessary in many ways to the general health of an orchard. It pulverises the earth and allows aeration of the soil, and the water retaining capacity of the land is increased. Rain more readily penetrates to the deepest layers, and evaporation is checked by the reasonably fine top mulch produced by good tillage.

In Rhodesia we must always be prepared for a possible shortage of rain, quite apart from the certainty of a period of six or even seven months when no appreciable rainfall can be expected, and our system of cultivation must be adapted accordingly.

Before the wet season arrives the orchard should be thoroughly cultivated so as to be in a condition to receive the greatest possible benefit from the rains that may fall. When the cultivation is completed, and after the first good rains have fallen, it is advisable to sow a cover crop of sunn hemp or some kind of bush bean over the whole area between the trees. When the cover crop has attained its maximum growth, and if the rainy season is drawing to a close, or if the orchard soil is not too wet to plough, the crop should be turned under by ploughing first in one direction between the rows with a mouldboard plough to a depth of from five to six inches, and then when the turned under cover crop is sufficiently decomposed and it is not likely to be dragged out of the soil again, the grove should be cross-ploughed, this time to a depth of about eight inches. By setting the plough at the greater depth when cross-ploughing no vegetable matter will be left on the surface of the soil.

When the ploughing and cross-ploughing have been thoroughly done, the soil should be well harrowed in both directions.

The unploughed soil under the trees should also be dug over at this season of the year, when all the weed growth and fallen leaves will be turned under An ordinary digging spade is best for this work, as the hoe or fork is more likely to damage roots.

When the entire orchard has been worked by ploughing and digging it should secure fairly frequent cultivation, the period between these cultivations not usually exceeding one month. Cultivation is also necessary when the soil is sufficiently dry after each irrigation.

Inter-cropping.—Under some circumstances young orchards may be successfully inter-cropped, but this should not be attempted unless proper cultivation can be given and manure can be liberally applied. Inter-cropping enables the man with limited capital to overcome the initial expense of cultivation and incidentally leads to regular cultivation between the trees. Tall growing plants such as maize should be avoided, and the inter-crops should be restricted to such as peas, beans, tomatoes, potatoes, etc., whichever suit the conditions best and are likely to be the most profitable.

Where no irrigation is practised inter-planting should only be confined to the rainy season, and then only to such crops as will mature before the approach of the dry season.

Diseases.—When considering the question of diseases, adopt the principle that prevention is preferable to attempted cure; most diseases are preventable, few curable. Many home orchards are neglected from the time disease and pests first make their appearance. This would not be the case if growers when establishing their orchards would look upon spraying as one of the essential cultural operations. Many trees planted by the pioneers did well for a time, but when disease made its appearance they were abandoned.

To maintain fruit trees in good and healthy condition, make a practice of spraying annually with a fungicide. Spray in winter before the trees start growth. A good spray for this season of the year is lime sulphur mixed according to the directions on the container. Proprietary lime-sulphur is recommended; home-made solutions take time and are so often incorrectly made. This winter spray acts as a tonic to the tree: it is also an insecticide as well as a fungicide. Bordeaux mixture is also a good spray for winter or summer use. It is a fungicide purely and simply. Use the formula 4.4.50, that is 4 lbs. bluestone ($CuSO4$), 4 lbs. quicklime (CaO) and 50 gallons of water. For tender plants use half strength—

4.4.100. This spray may be used for any disease control. The novice is recommended to use the proprietary prepared Bordeaux. It is usually bought in small quantities from stores stocking horticultural supplies.

In preparing home-made Bordeaux mixture, quicklime of good quality is best. If this calcium oxide content is low more lime must be used.

Stock Solution.—Dissolve 4 lbs. bluestone (CuSO4) in 4 gallons of water. Use a wooden or earthernware vessel. Metal containers must not be used, for they will corrode and the spray may be spoiled. Next take 4 lbs. quicklime and slake. This is done by adding water gradually to the lime until the burnt lime breaks down and forms a fine powder. When water is added to the lime a chemical change takes place: heat is generated during the process, and if water is added in moderation the slaked lime will become a fine white powder. This slaked lime is next added to 4 gallons of water and stirred well. We now have two stock solutions containing 1 lb. of lime or bluestone to the gallon of water. To make up the mixture on a small scale procure a wooden barrel and add $10\frac{1}{2}$ gallons of water; next take 1 gallon each of the stock solutions and pour simultaneously into the barrel containing water. If free bluestone (CuSO4) is in the mixture it is dangerous to apply it to trees in foliage.

Test.—Dip the blade of a clean knife into the mixture after well mixing it, and after a minute's immersion if the blade shows a copper coating more lime water must be added to neutrialise the excessive blue stone (CuSO4).

Agitate the mixture when spraying. Stock solutions will keep for a considerable time if covered and protected from the air.

Hardy deciduous trees may be sprayed in winter with a solution of 1 lb. bluestone to 25 gallons of water. This is very effective in preventing disease and lichen growth. *It must not be used on foliage or tender plants, for they will be killed.*

Insect Pests.—A knowledge of the feeding habits of insects is essential if pests are to be controlled and good sound fruit grown. A simple classification is as under:—

1. Chewing insects.
2. Sucking insects.

When spraying to combat the ravages of chewing insects a poison mixture must be used that will not damage the fruit or foliage. The best spray is arsenate of lead, $1\frac{1}{2}$ lbs. to 50 gallons of water. The spray must be well atomised so that a fine film of poison is left on fruit and foliage when the trees dry after being sprayed, Chewing insects attacking the sprayed trees are poisoned before they do damage. It is sometimes necessary to spray several times, especially when insect pests produce more than one generation during the season. All fruit and foliage chewing insects may be controlled with this spray.

Sucking insects are divided into two distinct classes:—

(*a*) Those sucking food from the surface of fruit or foliage.

(*b*) Those sucking food from inner tissues of fruit or foliage.

Surface sucking insects (fruit fly, house fly) are best controlled by baiting attached plants with a sweetened poison. This must be sprayed on to the foliage of the treated plants or trees in small drops. Use the ordinary garden springe for applying, keep the mixture off the fruit as much as possible. Try to get bait in the shady part of the trees where the fly rests during the day. This treatment will kill most of the mother flies before they lay eggs. Treatment is started about three weeks before fruit ripens, and is continued to the end of the season; in dry weather about every ten days, in wet weather when foliage is dry after each rain. The mixture is poisonous to human beings and animals, and must be kept under lock and key. It is made up as under:—

2 ozs. arsenate of lead, powder.

$\frac{1}{3}$ gal. treacle, or $2\frac{1}{2}$ lbs. cheap sugar.

4 gals. water.

Dissolve sweetening matter in a little water, mix arsenate of lead, then add full quantity of water. Keep agitated while spraying.

Insects sucking their food from the inner tissues, such as scale of all varieties, must be sprayed or fumigated. The latter method is most effective, but not always possible owing to the cost of necessary equipment. The object in view when treating this class of insect is to burn or suffocate it. Resin wash is one of the best sprays for this work. If the trees are well and evenly sprayed the insects will have a complete film form over them. This when dry will exclude air from their breathing pores and they then die and fall off. Rèsin wash may be purchased from most firms stocking horticultural appliances, or it may be made up as follows:—

24 lbs. cheap resin (or 2½lbs);
5 lbs. caustic soda (or ½lb.);
2½ pints fish or cotton seed oil (or ¼ pint);
100 gals. water (or 10 gals.).

Heat 15 gallons water to about 150 deg. F., then add the caustic soda slowly and next the oil. When the mixture starts boiling add the resin gradually; keep adding water to prevent boiling over, and boil for about half an hour after all resin has been added. The mixture should have no lumps of resin in it, and the colour should be that of very strong tea. The added water should bring the quantity of concentrated spray up to 25 gallons: dilute to 100 gallons or 1 to 3 of water, and to obtain the best results spray when warm (not hot). Resin should be well powdered before adding to the boiling mixture.

Pests affecting the roots of plants are more difficult to control. These include nematodes, worms, woolly aphis on apple roots, etc. Soil fumigants are best for treating this class of pest; tobacco dust is good if worked into the soil round the trees. Vaporite is also used for this purpose: the latter is usually stocked by wholesale chemists.

General precautions must be taken against pests and diseases. Collect all visibly affected fruits and destroy them. Never leave fallen fruit on the ground for any length of

time. Boil or bury them very deeply. Such measures have a marked and beneficial influence on the control of all pests Hand collecting of some of the insect pests is necessary if they are to be checked or destroyed.

SUMMARY.

1. The best orchard soil is a light to medium light loam with good depth and drainage.

2. All orchards should be sheltered either naturally or artificially from the hot and dry winds experienced during the Rhodesian spring.

3. The best aspect for the orchard is a gentle southern and eastern slope.

4. Preference should be given to a site capable of being irrigated.

5. The site should be near the homestead.

6. The land should be well prepared and graded before planting.

7. All holes should be dug two 2 square and 2 feet deep, then be filled with good surface soil.

8. Trees should be planted at the correct spacing, if necessary so arranged that short-lived trees may at a later date be taken out to furnish more growing room for longer lived larger trees.

9. Trees should be ordered well in advance of the planting season; this ensures securing the desired varieties.

10. Deciduous trees must be planted in June and July. citrus and evergreen trees generally early in the rainy season.

11. Buy first size healthy trees from an established nurseryman.

12. Choose varieties suitable for the zone you wish to plant them in. Cherries will not grow at Mazoe, nor will paw-paws grow at Inyanga Hotel.

13. If trees are dry and shrivelled on receipt, treat them as directed.

14. Plant trees no deeper than they stood in the nursery; deep planting is fatal to most trees.

15. Certain varieties must be planted side by side for inter-pollination purposes. Bordeaux wash, or affix wooden slats on the western side of the stems of young trees; this prevents sun-scald.

16. Pruning is essential with most deciduous fruit trees. In order to regulate the crops the owner must understand the fruit-bearing habits of the trees to be pruned. Vigorous trees require light pruning and weak trees heavy pruning.

17. Winter pruning should be performed when the trees have shed their leaves. Summer pruning is done during the growing season.

18. All deciduous trees should be shaped like a goblet or wine glass. This allows air and light to penetrate to the inner branches. In Rhodesia the trees must not, however, be kept too open in the centre.

19. All dead, weak and diseased wood must be cut out; also branches that cross or crowd each other.

20. All unprofitable trees should be replaced with good varieties either by re-planting or top-working.

21. It is a mistake to allow trees to fruit too young; this causes dwarfing, and they are of little value in later years.

22. The fruit should be thinned out of all trees that have a tendency to over-produce; 100 good large fruits are better than 500 small ones.

23. Fruit thinning must be done soon after the fruit has set; late thinning is useless.

24. When harvesting fruit, handle it as you would eggs.

25. Use a ladder on large trees; other methods end in broken limbs of trees or pickers.

26. Over-ripe fruit is often unpalatable; harvest all fruit at the correct stage of ripeness. Many late apples, pears and other fruits may be stored for several weeks.

27. All trees should be watered when they are in need of it; fruit crops will fail if the soil is dry when the trees are in blossom. When possible, irrigate all fruit trees before they blossom, and citrus trees again when in full flower.

28. Fruit trees are incapable of producing annual crops of good fruit without being fed. They should be fertilised and manured from the time they commence to bear. Large trees require more feeding than small ones.

29. Early autumn is a good time to feed trees, as the food may then be ploughed under with a creen crop.

30. Sunn hemp is the best green crop to grow between the trees, for ploughing it under furnishes a large amount of humus-forming material, which is particularly valuable if farmyard manure is not available.

31. Good cultivation is essential for successful fruit growing. Plough the ground in autumn, loosen the soil under the trees and harrow occasionally to produce a good tilth and conserve the soil moisture.

32. Cultivation enables the roots to receive sufficient air, which is so necessary for their healthy development.

33. Inter-planting of young orchards may be practised. Tall growing crops are unsuitable, since they exclude air and light from the young trees. Do not inter-plant large trees; they require all the air, space and plant food available.

34. Spray in winter with lime sulphur; this prevents disease and destroys pests.

35. Leaf and fruit chewing insects may be killed by spraying their food supplies with poison.

36. Sucking insects are destroyed by poison baits or a caustic contact spray.

37. Most spray mixtures are poisonous things. They should be kept under lock and key, and be handled with great care.

38. The Government Horticulturist is employed by the State to give advice on fruit culture. Make use of him.

Farming Calendar.

LIVESTOCK.

JULY.

Cattle.—The bulls may again be put into the herd at the end of the month. Watch for any unthrifty cattle and get them into the home paddock and feed them before they become really poor. The value of a good provision for winter feed will be apparent now. Except under purely ranching conditions winter feeding should be general. Where areas have been properly reserved for winter grazing these should be in use now. Generally the treatment of the dairy herd should be continued on the same lines as in June.

This is one of the coldest months of the year, and milk production as a rule is low. Those cows which are being milked should receive a full winter ration of succulents (ensilage, pumpkins or majordas), hay

Sheep.—As for June, where necessary dose for hookworm.

AUGUST.

Cattle.—On the early granite and sand veld probably the worst of winter is over so far as grazing is concerned, and a nice bite of green grass is appearing. Care should be taken where cattle are allowed to graze on the early burnt grass not to let them get too much at first. On red soil farms the haystack will still be required, and in all cases a certain amount of hay or ensilage should be held in reserve against the possibility of very late rains. In dairy herds on any soils whatever, feeding, housing and bedding should not be relaxed.

Calves, especially young ones, must be carefully watched; they should not run too far, and are better inside, except when the weather is warm. They should be fed a little sweet hay, bean meal, linseed, ground nuts or ground nut cake and a small ration of green food.

This is usually a critical time of the year for young dairy stock. For dairy heifers, weaned calves, etc., there is possibly no better ration than one consisting of maize silage, legume hay and small allowance of mixed concentrates, and these feeds, if supplied in liberal quantities, should serve to keep the young stock in a thrifty, growing condition.

Sheep.—In many places there will be grazing on early burns, see that the ewes and lambs get the best. In the drier parts this is one of the most critical months. A stack of bean hay and a little maize will solve most of the troubles.

SEPTEMBER.

Cattle.—Ranching cattle go through a very critical time from now on. Where possible, it will be wise to keep an eye on those cows that may be expected to calve early, with a view to feeding them if necessary and seeing that they do not get too poor The supplementary feeding of ranch stock is always a difficult problem. But a small provision of cotton seed, good veld hay, kaffir corn or sunflower silage at this time may be the means of saving many head of cattle when the rains are late. This is a critical month for young stock. Weaning should be completed as soon as conditions permit. The dairyman will carry on much as in August; he will, however,

use his discretion (in accordance with the condition of his veld) as to the use of ensilage, pumpkins or other bulky and succulent food. He will be wise not to shorten the supply of concentrated foods for some time to come. A little hay or ensilage should still be kept in reserve until the rains have fallen in reasonable abundance. The object should be to build up the condition of the cows expected to calve when the rains come.

Sheep.—Same as for August, except that March lambs, if well grown, should be weaned and either put on to good grazing or allowed ample bean hay and a little maize. A little feed now will ensure that they will be ready to top the Christmas market. Where nodular worm is present dose twice at 30 day intervals as was recommended for January.

OCTOBER.

Cattle.—Ranching cattle on granite veld will in many instances be in fairly good condition on account of the early grass in the vleis, etc. On the diorite soils and later veld the cattle owner will still have to watch his weaker cattle carefully. In any case all supplies of hay, ensilage, majordas, etc., should be carefully husbanded in anticipation of possible late rains, but at the same time every effort should be made to prevent cattle becoming weak.

During the month of October and until such time as the rains have commenced and green-grazing is available, dairy stocks requires to be almost entirely stall fed. Cows in milk and cows due to calve should be liberally fed on succulents and concentrates in order that they may commence the dairying season in good condition, and make full use of the early grazing for milk production. Dairy cows that are underfed at this time of the year invariably produce milk of poor quality, and usually throw weedy undersized calves; furthermore, they do not pick up in condition until comparatively late in the season.

During October, the cow's ration should consist of succulents such as silage or green feed, etc., legume hay of good quality and a liberal allowance of concentrates; a pound or so of a feed such as ground-nut cake is invaluable for dairy stock at this time of the year.

Sheep.—The rams should be put in now to ensure March and April lambs. Good green grass or a bit of supplementary feeding will flush the ewes and ensure a bigger crop of lambs. Keep the rams in during the day and feed them. Continue dosing the weaners well. Commence dosing very regularly, and in the more moist areas keep all sheep out of the vleis.

NOVEMBER.

Cattle.—Normally rains should have fallen and the veld should be plentiful now. Beyond careful dipping, ranchers should not have much worry. If the season is bad, the poorer cattle should be drafted out and given a little hay, ensilage or maize daily.

In a normal year veld grazing should be plentiful in November, and the feeding of dairy stock is then very much simplified; veld grass in a green and succulent condition is practically all that is required for animals of less than average production. Heavy milking cows, however, on early pasture, require extra feed in the form of concentrates, while the latter should always be fed to dairy stock which are in poor condition at this time of the year. Young calves should not be turned out to graze with the herd, and in wet weather are best kept in a clean, dry, airy pen. Weaned stock, which have not hitherto had access to green pasture, should be gradually accustomed to the change in diet and may at first be turned out to graze for short periods. Young stock on pasture should also receive a small daily allowance of concentrates.

Sheep.—The rams should now be working well, only allow the rams with the ewes at night. During the day they should be kept at home and allowed with the ewes from 4 in the afternoon until 8 or 9 in the morning. Keep all sheep on the high dry lands. Where hookworm is present dose now.

DECEMBER.

Cattle.—Feeding should be continued on the same lines as in November. Keep a close eye on any store bullocks that have been selected for fattening on grass.

Ranching cattle should not require any attention beyond dipping. Every effort should be made to have all the female stock in good condition for the breeding season.

During the months of December and January veld grazing is usually plentiful, and very little extra feed in the form of concentrates is required for dairy stock. It should be borne in mind, however, that heavy milking cows are unable to satisfy their requirements for milk production from veld grazing alone, and should receive a daily allowance of grain; the latter should be fed at the rate of 2 lbs. for every gallon of milk produced daily, *i.e.*, a cow producing three gallons of milk should receive 6 to 7 lbs. of concentrates. An excellent mixture for this purpose is one consisting of four parts maize meal and one part ground-nut cake.

During wet weather, the provision of a clean dry shelter for calves is essential; the latter should not be crowded together in a small, damp, badly ventilated pen or muddy kraal. When treated in this manner, a calf is very liable to contract various ailments such as scour, etc. Scour is entirely preventable, and is usually caused by over-feeding, or feeding from dirty pails, feed boxes, etc. Calves which contract scour should be isolated, the milk ration reduced, and they should be dosed with a few tablespoonfuls of castor oil.

Sheep.—The rams should be taken out before Christmas and not run with the ewes throughout the year. Keep all sheep out of the vleis and dose regularly for wireworm and bankrot worms.

DAIRYING.

JULY-AUGUST.

No difficulty should be experienced in producing first-grade cream at this time. In cold, windy weather due precautions should be taken to ensure that the milk when separated is not below 90 degrees.

Most cheese-makers cease their cheese-making operations at the end of the month, as milk is usually scarce. Cheese in the store-room should be carefully watched, as cheese mite is likely to appear on old mature cheese. In order to prevent the undue drying out of the cheese, the floor of the cheese room should be sprayed with water from a watering can.

SEPTEMBER.

This is generally the quietest month of the year from a dairying standpoint, as the production of dairy products is at its minimum. Town milk supplies are now falling off, and a greater use of purchased concentrates in the form of ground nut cake and bran is advisable to keep up the milk supply. Very little cheese is made during this month. Old cheese should

be cleared out of the store-room before the advent of hot weather, and if possible should be sent to be stored under cold storage conditions. Considerable difficulty is to be expected in making butter during this month, as the early spring grass is shooting in the vleis and the butter is consequently very soft. To counteract this, greater use should be made of feeds which produce a hard fat, such as cotton seed cake.

OCTOBER.

Weather conditions are generally fairly warm during the month of October, and every precaution should be taken to keep the cream, which is used for butter-making or which is sent to the creamery, as cool as possible. The can or bucket containing the cream should be placed in a basin of water or concrete trough, in the dairy, and exposed to a draught; a piece of kaffir blanket, which dips into the water, should be wrapped around the can or bucket containing the cream. Churning of cream for butter-making is best carried out early in the morning—before sunrise if possible; the coolest water obtainable should be used for washing the butter whilst in the granular stage.

At this season of the year cheese-makers may find that the milk is deficient in butter fat; this is generally the result of under-feeding or unsuitable feeding. Cheese made from milk of low fat content is invariably dry and hard, defects that are accentuated by over cooking the curd or by cooking at too high a temperature. The curd should be firmed in the whey at a temperature not higher than 98 to 100 degrees F.

NOVEMBER.

Farmers supplying cream to the creamery should adjust the cream screw to the separator so that the latter will separate a cream testing 45 per cent. butter fat. Cream of this consistency will keep better than thinner cream. It should be borne in mind that it is practically impossible to produce first-grade cream if the cattle are milked in a muddy kraal. In the absence of a cow shed, every endeavour should be made to erect a small milking shed in which four or five cows can be tied, milked and fed. A small shed of this kind is also essential to obtain clean milk for cheese-making. Milking in a muddy kraal invariably results in a gassy, bitter cheese being produced.

The shelves of the cheese room should be scrubbed with boiling water and soda, and for the last rinsing a weak solution of formalin may be used. This should prove effective in controlling cheese pests.

DECEMBER.

Under the weather conditions which now obtain, cream should be despatched to the creamery at least three times a week. It is of the greatest importance that cream should be cooled immediately after separation, and should be kept cool while on the farm and whilst in transit to the railway station or siding. While the cream is being cooled, it should be frequently stirred, using a stirrer with a plunger attachment. Warm, freshly separated cream should not be mixed with old cream which has already been cooled. Cool the fresh cream first and then mix thoroughly with the old cream. Gassiness is a common defect in the cream received at the creameries at this time of the year, and is caused by gas-producing organism with which the milk and cream are contaminated. These organisms abound in mud, manure, etc., and develop and multiply very rapidly at high temperatures. Any precautions therefore which may be taken to eliminate dirt, manure, etc., from the milk and to keep the cream cool will prevent the development of gassiness.

As the night temperatures are fairly high, cheese-makers should not attempt to use night's milk for cheese-making; morning's milk plus a starter will give the best results. Gouda cheese-making operations are not usually successful at this season of the year, owing to the poor quality of the milk and the prevalence of gassiness. This type of cheese is best manufactured during March and subsequent months.

FORESTRY.

JULY.

Care should be taken to protect all plantations from fire by hoeing belts round them and burning any grass likely to be dangerous. Cuttings of various deciduous trees may be taken and struck in nurseries. Continue pricking out conifers into tins or beds. In preparation for early planting in case the season is favourable, limited sowings of eucalypt seeds may be carried out. If labour is available, preparation of land for planting to be taken in hand.

AUGUST.

Seed beds may be prepared and eucalypt seeds sown if required for planting early in the season. Make sure that all fireguards are in order.

SEPTEMBER.

All cuttings struck in sand in July and not yet transplanted into good soil should have this done as soon as possible. Preliminary sowings of eucalypt seeds should now be made, so that transplants will be ready in case the first half of the rainy season should prove favourable. The fire season will now be at its height and care should be taken to see that all plantations are protected.

OCTOBER.

The main sowings of eucalypt seeds should be made either in seed trays or in well prepared seed beds. A well-broken soil forming a fine tilth in the seed bed ensures more successful germination and better plants. If transplants are being used, any seedlings which are ready should be pricked out.

Seedlings in open beds may have their tap roots cut so as to develop fibrous lateral roots, and thus produce good type stocky plants. Remember the plant feeds through its roots, hence the better root system the healthier the plant and the greater its chances of successful establishment. If conditions are favourable, cross-plough and harrow land for planting broken up in early autumn. Continue to guard against fires.

NOVEMBER.

The sowing of eucalypt seeds should be completed by the middle of this month. If fresh seed of cedrella toona is available, sowings should be made. Keep the seed beds moist and free from weeds. The tap roots of early seedlings may be cut back in order to form hardy, stocky plants most suited for planting. Continue with pricking out if transplants are to be used. Prepare all land to be planted by cross-ploughing and harrowing. A well prepared soil is a good fertiliser; it assists establishment and reduces failures. Fires are still a menace, and all fireguards should be kept in order.

DECEMBER.

Final preparation for planting should be made, including harrowing or pitting. Early plantings may be carried out if the season is a good one. Planting should be carried out on dull, rainy days, or failing such day, late in the afternoon. Great care should be exercised in planting out to avoid bending the tap root, and to set the trees in the ground at the same level as they were in the seed bed or tray. Late sowings of cedrella toona may be made.

CROPS.

JULY.

Support agricultural shows, and add to your list of exhibits. Advertise your goods through the shows. Interested people will see them. If you require to make purchases of seed for next season, judge by the exhibits on the show what grower can best supply your needs, and place your orders accordingly. Attend the shows and go there to learn all you can about your business. Seed maize previously selected in the field should be butted and tipped and hand shelled. Keep the butt and tip grain for check row planting by hand. Do not over-irrigate winter crops, and do not irrigate when the wind is from the south, as this often means frost at this time of year. Troublesome weeds, such as darnel grass or drabok, may be removed from cereal crops by hand. Ploughing should be pressed on with, and maize stalks and roots of maize and other trash from the crop should be collected and burned or composted. A land littered with unburnt and unrotted stalks and roots cannot be brought to a suitable tilth for planting and subsequent cultivation. Silage and sweet potatoes and other succulent feeds will have come into general use now, the potatoes being lifted from the land as required. The application of phosphatic fertilisers which are to be ploughed or harrowed in can be begun. Take the opportunity, during this and the next month or two, of inspecting all boundary and paddock fencing and gates, and effect repairs where required. Give a coat of paint to implements, wagons and carts. This protects the woodwork from rotting and iron from rust. If not already marketed, the main potato crop will probably be sold about now.

AUGUST.

Prepare your compost heaps. Grade the potatoes properly according to size. The buyer wants potatoes—table or seed—of even size, not large and small mixed. Select and clean farm-grown seeds ready for next season's planting. Label the bags with name and weight of contents. Build a proper shed for your seed potatoes. Sort over seed potatoes in store and remove any diseased or rotten. Green oat or barley fodder on wet vleis, or under irrigation, will become ready for cutting. Press on with ploughing and cross-ploughing. Decide what crops are to be grown next season, and, if you think fit, discuss the matter with officers of the Department of Agriculture. If you have not already effected all your purchases, consider the question of what seed you will require to buy for next season. If in doubt, consult the Department of Agriculture. In frost-free situations, potatoes can be planted for an early crop under irrigation or on damp land. Cart and spread your farmyard manure and plough it under as soon as spread to avoid loss. If you have any long stable manure, apply it to your heaviest

land. The application of fertilisers to the land can continue. If you do not already have one, put up an implement shed, even if it be only poles and grass. Keep wagons and Scotch carts under a similar shed or in the shade of trees. Speed up the making and burning of bricks if this is still in progress.

SEPTEMBER.

Prepare your compost heaps. Utilise your labour to the fullest extent for stumping and clearing more land for mixed crops and for general farm development. Do not be satisfied unless each year sees more profit-earning development work effected. Good organisation of the farm work will permit of much being done without great cost. Begin marking out holes for hand check-row planting of maize, and apply manure or fertiliser. Fertilisers which are to be broadcasted and ploughed or harrowed in can be applied. Lands which have been green-manured in March or April will require a second ploughing about this date or before being seeded. Danger from frost should be past now, and crops susceptible to frost, such as potatoes, onions in beds for the summer crop and Jerusalem artichokes, may be planted where lands are moist. Pumpkins and early maize may be planted on vlei lands. Edible canna may be planted "dry" during the latter half of this month. Overhaul all implements and replace worn parts. Putting this off till the planting season may mean serious loss of planting opportunities. Ploughing and cross-ploughing should be hurried on with; also the ploughing under of farmyard manure. Make every effort to secure as good a seed-bed as possible; good seed-beds mean good stands, and good stands are all-important in securing good yields.

OCTOBER.

Prepare your compost heaps for the rains. If not already attended to, overhaul all farming implements and replace worn parts to ensure efficiency. Shell ground nuts required for the season's planting. Ploughing of old lands should, at latest, be finished this month. If seed potatoes will not keep in good condition until next month, they may be planted now, but they must be planted deep. Edible canna may be planted this month before rain falls. Also velvet beans, dolichos beans and sunnhemp towards the end of the month for green manuring. Harvest winter cereals and plough under the stubbles as soon as possible after harvest. When rains have fallen, use every effort to improve the tilth of the lands which will be the first to be planted. On cloddy lands already ploughed, seize the opportunity to break down the clods by disc and drag harrowing as showers of rain fall. A spiked roller is very useful for this work. A good tilth means good planting, and a good stand of maize.

When necessary, keep the harrows going to check early weed growth. Clean lands at this time of year are an insurance against cutworm and other insect pests. If weather conditions permit, plant a trap crop of maize to attract the stalk borer. New land to be ploughed and intended for planting this season should be cleared of heavy grass or weeds by burning or cutting to ensure good work being done by the ploughs. Seasonal showers of rain are liable to spoil bricks unburned. See that bricks which have been made are protected from rain. Clean out guttering and down-spouts of house and farm buildings. Press on with development work so as to have this completed before rains break.

NOVEMBER.

Have you a reserve of seed maize for replanting? Take note when the first rains fall, and see what leaks there are, if any, in the farm buildings. Do not neglect to effect such repairs as are necessary. Early in the month see that the planters are in perfect order, and that they drop the different seeds to be planted evenly and at the right distance. Try them out on the farm road. Hasten the work of getting the lands for early sown crops into as good a condition for seeding as possible, so that the first and most favourable opportunity for planting may be seized. The young plants make more rapid growth in a good seed bed. Utilise exceptionally early rains for this purpose rather than for planting. The holes for check-row planting of maize can continue to be prepared until sufficient rain has fallen to allow of planting. Velvet beans and dolichos beans for seed or hay may be planted dry if the land is in good order. With favourable weather, planting of maize, velvet and dolichos beans will commence about the middle of the month, and will continue as the condition of the land and the rainfall permit. Main crop potatoes should be planted for now on to January. Dhal may be planted for seed or green manuring—if for seed, a frost free situation is necessary. Kaffir corn for seed may be planted this month. Green-manure crops requiring a long growing season should be planted. Destroy, by feeding or burning, early planted trap crop of maize or volunteer plants which have become infested with stalk-borer. Plant the first of two traps for witchweed before the rains. It can be sown on a stubble and covered by disc-harrow.

If weeds are beginning to show, keep the harrows going in front of the planters. If weeds are too advanced to be killed by drag harrows and too numerous to be dealt with by hand labour, use the disc-harrow or lightly re-plough the land. If the tilth is good, do not be afraid to harrow the young maize. This will save much labour later on by destroying the weeds while they are small.

Check-row your maize to reduce hand labour on witchweed control, or plant at 6 feet by 9 inches and use a spring-tooth cultivator.

DECEMBER.

Keep the cultivators going, both on planted and unplanted lands, whenever weather conditions are favourable. Destroy the weeds while young and before they obtain a firm root-hold. Turn your compost heaps after top 6 inches is wetted; and on a wet day.

Continue planting maize, beans and ground nuts as early as possible this month, followed by sunflowers, Sudan grass, manna, pumpkins and cattle melons. Linseed, cowpeas, teff grass, Kherson and S.E.S., oats. Sunnhemp should be planted after the other crops are in. Ensilage crops may be sown at the end of the month. When harrowing young maize this work should be done in the heat of the day when the young plants are flaccid and not easily broken. On lands not yet planted the crop of weeds should be kept down by disc harrowing. It is a good plan to harrow or disc-harrow immediately before the planter, or alternatively to follow the planter with a light harrow. Treat seed oats and sorghums for smut before sowing. Earth up early planted potatoes. Keep a look out for the stalk-borer, and top or otherwise treat affected plants. New lands and old pastures may be broken, as circumstances permit, during December, January and early February, and again ploughed from May to July. If they carry a heavy crop of grass it should be burnt to enable good, clean ploughing to be done and to kill witchweed seed. Sweet potato slips should be planted early in this month. Every farmer should have in a few acres of this valuable crop.

Southern Rhodesia Weather Bureau.

JULY, 1937.

New Series.—The tabulation of monthly means has been altered and additional data is given.

Pressure.—Mean pressure for the month was generally above normal.

Temperature.—Mean monthly temperatures were well below normal varying from —1.5° to —4°F.

Humidity and Rainfall.—Very little rain was recorded and humidity was generally below normal.

Weather Features.—A deep low passed along the south coast from the 1st to the 4th giving light winds and warm weather. The succeeding high affected the country on the 5th and 6th with strong winds, cloud and cold weather. Anticyclonic conditions prevailed until the 13th when a big low again affected the country; the succeeding high approached on the 14th and 15th with cloud and strong cold southerly winds. Normal conditions appeared on the 17th as the high weakened and the ordinary winter fine weather prevailed for the rest of the month.

PRECIPITATION.

Station.	Inches.	Normal.	No. of Days
Angus Ranch	0.03	0.13	1
Beit Bridge	0.00	0.18	—
Bindura	0.00	0.03	—
Bulawayo	0.00	0.05	—
Chipinga	0.51	0.60	9
Enkeldoorn	0.00	0.08	—
Fort Victoria	0.18	0.10	1

PRECIPITATION.

Station.	Inches	Normal.	No. of Days
Gwaai	0.00	0.00	—
Gwanda	0.00	0.07	—
Gwelo	0.07	0.02	3
Hartley	0.00	0.01	—
Inyanga	0.00	0.11	—
Marandellas	0.05	0.07	1
Miami	0.00	0.06	—
Mount Darwin	0.00	0.01	—
Mount Nuza	0.42	1.23	4
Mtoko	0.00	0.02	—
New Year's Gift	0.15	0.27	3
Nuanetsi	0.00	0.23	—
Plumtree	0.00	0.05	—
Que Que	0.00	0.02	—
Rusape	0.03	0.17	1
Salisbury	0.00	0.02	—
Shabani	0.00	0.04	—
Sinoia	0.00	0.03	—
Sipolilo	0.00	0.02	—
Stapleford	0.42	1.07	8
Umtali	0.08	0.30	3
Victoria Falls	0.00	0.00	—
Wankie	0.00	0.00	—

JULY, 1937

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	8-30 a.m. Wet Bulb.	8-30 a.m. Dew Point	8-30 a.m. Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days: Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
gus Ranch... ...	...	55.8	50.9	47	4.6	72.2	46.5	59.3	83	26th	42	8th	...	9	...	...	...	...	...	...	...	...
tbridge...	1,500	57.1	50.9	46	5.6	75.8	47.3	61.5	87	25th	38	8th	4	6	...	1	61.2	972.9	887.6	...	3.2	...
idura...	3,700	54.5	47.9	41	5.7	71.7	43.9	57.9	81	26th	37	23rd	...	8	...	3	58.5	896.9	886.5	...	2.3	...
lawayo	4,393	52.1	45.1	37	5.8	67.1	41.9	54.5	79	26th	38	14th	...	20	...	6	53.8	874.6	886.4	873.4	2.2	9.1
ipinga	3,685	56.8	51.0	46	5.5	66.0	47.7	56.9	79	25th	42	15th	...	22	...	...	55.4	898.1	887.1	...	4.0	...
keldoorn...	4,788	51.7	46.4	41	4.5	65.7	41.5	53.6	79	26th	36	30th	...	22	...	8	52.6	862.1	886.5	...	2.9	...
rt Victoria	3,571	52.5	47.4	43	4.2	67.9	41.2	54.5	80	23rd	33	7th	...	18	...	15	54.5	901.7	887.0	...	3.7	...
raai Siding	3,278	48.5	42.4	35	4.8	75.7	36.6	56.1	85	27th	30	9th	...	4	...	20	...	909.5	885.0	...	0.6	...
randa...	3,233	53.5	46.8	40	5.6	69.5	42.2	55.9	81	25th	32	8th	...	14	...	11	55.8	912.7	886.8	...	2.4	...
relo	4,629	49.2	44.4	39	3.8	65.4	39.9	52.7	77	26th	31	8th	...	23	...	15	52.2	867.1	886.5	...	2.8	...
rtley...	3,879	53.7	47.1	41	5.5	71.0	39.9	55.5	81	26th	34	20th	...	11	...	17	55.0	890.7	860.0	...	2.2	...
ranga...	5,503	53.1	45.7	38	6.2	64.5	38.3	51.4	77	26th	32	3rd	...	26	...	19	...	840.6	...	...	1.7	...
randellas	5,453	50.9	45.2	39	4.7	63.8	42.2	53.0	74	25th	35	15th	...	24	...	9	52.2	841.5	...	...	2.7	...
ami	4,090	56.6	49.7	43	6.2	70.0	44.3	57.1	80	26th	39	21st	...	17	...	1	56.1	883.3	885.4	...	2.2	...
ount Darwin ...	3,179	58.1	51.1	45	6.5	72.7	43.0	57.9	82	26th	36	3rd	...	8	...	8	58.1	912.9	...	...	3.2	...
ount Nuza	6,668	44.9	41.6	37	2.6	53.3	39.7	46.5	67	25th	30	16th	...	31	...	17	45.0	804.3	886.2	804.1	5.3	...
oko	4,141	56.2	49.7	43	5.8	68.4	46.6	57.5	77	26th	42	16th	...	22	...	...	57.2	882.4	886.1	...	0.7	...
w Year's Gift...	2,690	53.4	50.5	48	2.6	70.8	45.3	58.1	83	26th	39	3rd	...	11	...	1	...	...	...	...	...	6.3
anetsi	1,581	56.7	49.7	43	6.2	75.4	43.3	59.3	86	26th	35	8th	...	...	...	...	...	970.1	887.5	...	2.1	...
ımtree	4,549	53.9	45.0	35	7.6	66.7	44.5	55.6	76	26th	34	14th	...	19	...	3	54.8	869.5	886.2	...	2.1	...
e Que	3,999	53.3	46.5	39	5.7	70.5	41.8	56.1	82	26th	37	3rd	...	12	...	6	55.7	887.0	886.2	...	2.3	...
sape	4,648	50.7	46.8	43	3.2	65.5	39.8	52.7	78	25th	33	7th	...	21	...	14	51.8	866.8	...	...	3.4	...
lisbury	4,831	54.2	46.9	39	6.2	68.3	42.0	55.1	77	26th	38	8th	...	21	...	6	54.4	860.6	886.3	859.5	2.3	9.0
abani...	3,131	55.8	48.1	40	6.7	69.0	44.1	56.5	82	26th	36	9th	...	17	...	3	56.3	...	...	...	3.1	...
ıoia	3,795	53.9	47.7	41	5.3	73.2	38.3	55.8	82	26th	33	23rd	...	5	...	23	55.3	893.7	886.3	...	1.8	...
olilo	3,876	58.1	49.7	42	7.6	70.5	44.0	57.3	80	26th	36	20th	...	15	...	2	...	890.1	886.0	...	2.0	...
ıpleford	5,304	49.0	45.9	43	2.6	59.3	35.8	47.5	74	26th	29	8th	...	29	...	21	...	846.1	886.3	...	3.8	...
ntali...	3,672	55.9	50.9	47	4.6	70.2	44.9	57.5	82	26th	40	7th	...	16	...	...	56.0	898.5	887.1	...	3.9	...
ctoria Falls... ...	3,009	53.7	47.3	40	5.4	77.8	40.4	59.1	87	23rd	34	26th	4	4	...	13	57.8	917.9	885.4	916.1	0.5	...
ankie	2,567	55.9	47.7	39	7.2	79.5	49.0	64.3	90	26th	43	19th	5	1	...	...	64.5	933.2	885.2	...	1.2	...

Southern Rhodesia Veterinary Report.

JUNE, 1937.

FOOT AND MOUTH DISEASE.

An outbreak occurred in the Ndanga East Reserve in the Ndanga Native district and in the Sangwe Reserve and Humani Estate in the Bikita native District.

ANTHRAX.

An outbreak occurred on Dangalima farm. Mortality, one head, all in contacts have been inoculated.

TUBERCULIN TEST.

One bull and twenty-four cows were tested upon importation with negative results.

MALLEIN TEST.

Forty-eight horses and twelve mules were tested during the month. No reactions.

IMPORTATIONS.

From the Union of South Africa: Horses, 48; Mules, 12; Bull, 1; Cows, 24; Sheep, 727.

EXPORTATIONS.

To the Union of South Africa—Oxen, 478; Cows, 8. To Northern Rhodesia—Bulls, 3; Cows, 651. To Portuguese East Africa—Oxen, 36.

EXPORTATIONS—MISCELLANEOUS.

To the United Kingdom in Cold Storage—Chilled beef quarters, 8,891; frozen boned beef quarters, 6,767; frozen

beef quarters, 4,053; kidneys, 3,448lbs.; tongues, 15,331lbs.; livers, 27,550lbs.; hearts, 7,548lbs.; tails, 4,519lbs.; skirts, 4,089lbs.; shanks, 15,227lbs.

MEAT PRODUCTS.

From Liebigs Factory—Corned beef, 104,926lbs.; meat extract, 31,426lbs.; rolled beef, 180lbs.; beef powder, 84,217 lbs.; beef fat, 14,200lbs.; meat meal, 30,000lbs.

B. A. MYHILL,
Actg. Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-37.

Monthly Report No. 56.
JULY, 1937.

During the month of July the only districts in which swarms of locusts have been reported, are Salisbury, Marandellas, Lomagundi and Mazoe. The reports refer to the Red Locust, (*Nomaracris septemfasciata*, Serv.). No damage has been reported.

RUPERT W. JACK,
Chief Entomologist.

Winning pen of grade Angus chillers at Bulawayo Show, 1937.

THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.

(Assisted by the Staff of the Agricultural Department).

PUBLISHED MONTHLY.

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Vol. XXXVI. OCTOBER, 1937. No. 10.

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Notice to Growers of Virginia Flue-cured Tobacco.—The attention of growers of Virginia Flue-cured Tobacco is drawn to the fact that it is necessary for them to make application for registration each year in terms of Section 19 of the "Tobacco Marketing Act, 1936," as amended.

Application for registration shall be made on or before the 31st October, 1937.

No grower shall be entitled to registration who does not so apply.

Applications shall be made in the prescribed manner as under:—

The Secretary,
Department of Agriculture and Lands,
Salisbury.

I hereby apply, in terms of Section 19 of the "Tobacco Marketing Act, 1936," as amended, to be registered as a tobacco grower.

(1) Name of Grower (in block capitals)............................

(2) Name of Farm (in block capitals)............................

(3) Postal Address (in block capitals)............................

(4) Registered No. previously allotted............................

Signed..................................

Date............................193...

Sale of Government Bulls.—The value of immunising imported livestock against Redwater and Gallsickness has been recognised for many years, and in order to maintain a vaccine which is safe and in no way detrimental to the future development and utility of the animal, it is necessary from time to time to test it on the most highly susceptible type of animal for which it may be required, viz., highly bred imported livestock. For this purpose the Director of Veterinary Research recently imported and immunised three young bulls. Hereford, Sussex and Aberdeen Angus.

They are of a high standard of merit and apart from their good conformation, quality and breed character they may be expected to prove to be good breeders' bulls, as in their pedigrees is represented some of the best "blood" of each breed.

The selection of these bulls was entrusted to Mr. Alex. Holm, C.M.G., C.B.E., Weybridge, Surrey, who was formerly Under Secretary for Agriculture in the Union of South Africa, and who will be remembered as an accredited judge of many breeds.

These bulls are to be offered for sale by public auction at the Veterinary Research Station, Salisbury, by Mr. I. Cohen on the 19th October, at 10 a.m. The particulars are as follow:—

Aberdeen Angus—Marquis of Froxfield, calved 2nd January, 1936.—Bred by J. F. N. Baxendale, Foxfield Green, Petersfield, Hampshire.

Hereford—Shrine Conway, calved 2nd January, 1936. Bred by J. H. Everall, Rosapenna, Shrewsbury.

Sussex—Petworth Loyal 16th, calved 24th January, 1936. Bred by Lord Leconfield, Petworth House, Petworth, Sussex.

The above animals have been Tuberculin tested and inoculated against Quarter Evil, Redwater and Gallsickness. These bulls have been approved under the Government Livestock Improvement Scheme and subject to funds being available this financial year a grant to an approved applicant may be considered.

Notes from the Wankie Game Reserve.—Thirty people visited the Reserve during August and a considerable amount of game of all kinds was seen. Guides are provided for tourists and this adds greatly to the chance of seeing animals which are often difficult to distinguish in their natural surroundings. Elephant appear to leave the neighbourhood of the roads on the approach of cars and this is attributed by the Game Warden to the fact that tourists talk when driving along. Elephant are probably able to hear human voices from a distance of several hundred yards.

Many of the smaller "pans" are now dry and elephant and other animals are consequently concentrating round the larger pans and boreholes.

These boreholes are pumped by windmills which deliver the water through a considerable length of piping into the "pans."

The delivery pipes have to be buried and the open end is set in concrete. Windmills are protected from playful elephants by deep trenches dug right round them.

Cattle on the Bulawayo Show.—The outstanding feature of the Bulawayo Show this year was the exhibit of fat stock.

The fat stock were probably the best lot that have yet been shown in Bulawayo and drew a comment from the judge from the Union that they were the best show of fat stock that he had seen in South Africa.

The bullocks were on the whole a very even lot and there were few tailenders. This is an indication that farmers are now feeding and finishing their bullocks off properly.

On the whole the cattle were the youngest exhibited for some time and a feature of interest was the Dawson Cup for the best six-tooth bullocks. This cup was presented by Mr. Dawson to encourage the feeding of younger cattle and the response was very gratifying.

Some of these young cattle were not as well finished as they should have been but it is likely that cattle for this class next year will be shown in better condition; as the exhibitors should now realise that young bullocks take more feeding than old ones to acquire the same finish.

The record price of 60 guineas was obtained for the best chiller ox, which was bred by Mr. C. C. Macarthur, Salisbury. This price eclipses last year's record of 45 guineas and it is probably the highest price that has been paid for a bullock in this Colony of recent years.

This ox was an outstanding animal of very good conformation and excellent finish and could compete in any fat stock show in the World.

The Aberdeen Angus bullocks exhibited were outstanding, Mr. Duncan Black winning most classes. The judges, however, had some difficulty in arriving at the final decision in many cases as the competition in all classes was very close. The Angus bullocks were exceptionally strong and showed well in all the classes in which they were exhibited. The Africanders were also very good. Professor A. M. Bosman, the Africander judge from the Union was particularly struck by the young Africander bullocks. Their finish was very good

and their weight for age was remarkable. In the Block Test which followed the Show one of these Africander bullocks was placed second to an Angus bullock bred by Mr. J. R. Stewart of Shangani.

In comparison the breeding classes were not nearly as strong as the fat stock classes and the demand on the Show Sale for pedigree stock was disappointing.

The Pedigree Show Sales at Bulawayo and Salisbury have been very disappointing of recent years but the low prices realised for pedigree bulls at the Bulawayo Show Sale should not be taken as an indication of lack of demand of pedigree bulls in the Colony. A number of bulls which did not fetch their reserve on the Show Sale have subsequently been sold at prices very near to their original reserve, and the general demand for bulls in the Colony at the moment is good.

Fattening Pens for Cattle.—The following letter kindly contributed by Mr. R. Vowles, Gaika Mine, Que Que, will undoubtedly be of interest to many of our readers:—

"Having seen in the last number of your JOURNAL, a sketch of a lay-out of yards for feeding steers in, I think the following may interest you.

A different arrangement of yards which I used in Canada was found to be most satisfactory. The fences and the feeding racks were constructed from timber cut on the farm. The round timbers were roughly squared, with an axe, at the ends; the planks were sawn at a local saw mill.

During the feeding period I had absolutely no help whatever. This was only possible because the stacks of hay and green feed were arranged so that a waggon could pass round them and along the front of the hay racks. The hay stacks were made narrow, 15 feet across and to a proportionable height, but as long as possible. It was therefore easy to load enough hay on to the waggon from the stacks, and easy to transfer it from the waggon to the hay racks. The green feed, i.e., oats cut green, were reaped with a binder, and being in sheaves was easy to handle. The sheaves were

put into round stacks to prevent heating, the diameter of the stack being 15 feet. Green feed was fed in the grain trough, being first laid out in front in a row from the waggon and then thrown by hand into the trough, the twine being cut at the same time. The bags of grain in like manner were set at intervals in front of the trough, then by holding the mouth of the bag over the trough and sliding it along the grain was spilled evenly into the trough.

For bedding the waggon was loaded with straw mostly oat straw, and drawn through the yards, an appropriate amount being thrown off in each yard, the steers scattering it themselves. The manure, which in the Canadian winter is frozen hard almost immediately, was thrown off the straw bed into heaps beside the fences and was removed as required after the steers had been marketed.

The grain ration fed was a mixture of oats and barley at the ratio of 4 to 1. During the grinding of the grain a tea spoonful of straight linseed for each steer was added.

The baby-beeves receiving a teaspoonful for four. This linseed was obtained from flax grown on the farm and is an excellent conditioner though owing to its strength it must be used with care.

The steers were started on 2lbs. of grain mixture per day and gradually increased to 10lbs. per day. In cold weather and when the steers were well on to their grain rations the barley proportion was increased to 3 to 2, but this was found too heating for warm weather, and had to be decreased again in the spring.

A strict routine was followed during the feeding period. First thing in the morning green food was given, one bundle to two steers or four yearlings. While the steers were eating this the manure was removed from the straw-beds. Then half the grain ration was given and the hay racks filled when the grain had been cleared up. While the steers were at the hay fresh straw was put down for bedding. This could be accomplished by 10 a.m. even in the middle of winter when it was not light until 8 a.m. After 10 a.m. the steers were left strictly alone and would, after finishing their hay, root

about in the straw for whatever odd grain and chaff it contained and then lie down from about noon till 3.30 p.m., providing they were not disturbed. The afternoon half of the grain ration was then given, another feed of green feed and the hay racks filled. This routine was strictly adhered to, the work of loading the waggons for the next feed being done while the steers were eating the feed just given, so that nothing went on in the stock yards between feeds. Thus the cattle soon got into the routine of eating and then lying down quietly, which is a very important part in the feeding of steers.

The cattle fed were range bred Shorthorn-Hereford or shorthorn-Angus first cross, bought in the fall weighing about 900lbs., and finished off about 1,200lbs. after 4 to 5 months' feeding. The baby beeves were from good grade Hereford cows and a pure bred Hereford bull. They were calved during April, ran with their dams all the summer and then gradually weaned in the yards by being attracted by grain through a gate held open so that calves but not cows could pass. Once they had started to come through freely into their own yard they were shut in for gradually increasing lengths of time until the cows were dry and the calves on to their own grain ration. These calves were finished off at between 400 and 500lbs. at approximately a year old. The price they fetched per lb. being about twice the price per lb. for 3 to 4 year-old steers. They require much more careful feeding and are easily made "grain-sick" in warm weather.

The breeding cows were fed a grain ration of 2lb. per day, and one sheaf of green feed for two, in the afternoon. During the day they foraged around the oat straw piles in the fields. The grain ration may seem small but it was started early in the winter and prevented the cows losing flesh then and kept them in good store condition

All cattle had continuous access to salt and water.

I give the above for interest and do not suggest it as a method for feeding under Rhodesian conditions. It does, however, show how labour can be saved by arranging the stock-yards and feeding yards in a convenient manner which

is proved by the fact that I was able to carry out all the work by myself with two steady horses to draw the waggon and an engine to grind the grain.

The Adaptation of Pasture Grasses to Their Enviroment.—There are some fundamental laws of nature which need to be fully appreciated by the farmer, since they are of great economic significance in farming practice. Of great importance is the law of plant succession. The flora of any given place, if left undisturbed, will ultimately be composed of plants which are best adapted to the prevailing local conditions of soil, rainfall, and climate generally. If the flora has not attained this equilibrium with the surroundings, it always has the tendency to change in composition, i.e., the plants that are better adapted usually oust those that are not so perfectly at home.

Hence an important thing to know is the ultimate result that can be expected in any given spot, and then to determine just at what point nature should be interfered with so that the maximum economic benefit can be obtained. Very often the result that is perfect in nature is not to the farmer's best commercial advantage. In such case it may be possible to put an artificial brake on the drift to natural perfection, and keep the flora at some particularly advantageous stage, or to modify the natural conditions in certain ways, e.g., by altering the fertility or the moisture content of the soil so that commercially profitable plants may be able to maintain themselves in competition with less desirable types.

When a pasture is manured, whether with natural or artificial fertilizer, the effect produced is not merely limited to the provision of more plant food for the grasses already occupying the ground. Another effect is, temporarily at least, to change the environment so that while the effect persists, the trend of the natural balance is in favour of new classes of plants rather than of those that were previously favoured. High-grade pasture grasses are generally able to utilise high soil fertility to a fuller extent than are

low-grade pasture plants. This explains why many artificial pasture grasses are able to maintain themselves better against weeds when fertilized regularly. The weeds cannot take advantage of the extra fertility to increase their aggressiveness beyond the degree already attained on poorer unfertilized soils, while the vigour of the pasture grasses becomes relatively greater than was the case prior to fertilizing. In a nutshell, the high-grade pasture grasses and the weeds are naturally adapted to different enviroments.

The plant succession is similarly affected by all natural enviromental factors. Some of these, such as veld burning, alteration of soil moisture by irrigation, and fertility, can be controlled to a certain extent, while others, such as general climatic conditions, are beyond human control. The observant man, therefore, will try to determine all the critical factors that can be utilized to his best advantage.—(Geo. A. Gill, Union of South Africa Department of Agriculture, Press Service).

SWEET POTATOES

It is thought that one of the reasons why such a valuable cattle feed as sweet potatoes is grown to such a limited extent in the Colony is because the usual methods adopted on the farm are laborious, and require so much hand-labour. The following description of the planting methods used by a Natal grower, Mr. J. F. T. Mostert, may be of interest and assistance to farmers here:—

"After preparing the ground I put a marker over the field. I made this myself out of an old planter frame, and three old planter wheels set 27in. apart; and with the usual disc marker also set 27in. from the outer wheel. On the wheels I fastened on cleats (pieces of H fencing droppers about 6in. long) set across the wheel and spaced at 16in. apart so I not only have the three rows marked, but also the position of each plant, and of course the mark for the outer wheel to return on. I now have one boy steering the marker, and two pulling it; and with five boys planting I set up two acres per day.

Two boys place the vine cuttings across the row on each mark, and a third boy comes along just after them with a stick like a walking stick, only it is about an inch thick, and slightly forked at the point. The boy places the end of the stick in the centre of the cuttings, and pushes it into the soil and firms it with his foot. One boy in this way can set 12,000 cuttings per day. The secret of course being that he does not have to bend down, and sets the cuttings almost as fast as he can walk. We set rooted plants in the same way, but it is much slower work than with the cuttings, unless the ground is very loose. In that case the boy presses the roots into the ground with the stick and firms the soil round them. If the soil is not loose enough he must first make a hole and push the plant roots first into the hole and firm the soil around the plant with his foot."

The above method is very suitable for planting pure stands of sweet potatoes, which are to remain down for several years, but normally a spacing of 32 to 36 inches between rows is advisable in Rhodesia. Where the crop is included in a rotation and can only occupy the land for one season, it is best to plant the cuttings between the rows of maize at the last cultivation of the latter in late January. The plants become well established the same season, and then have a whole season to produce tubers the following year. This method gives much heavier yields of tubers than if the crop is lifted in the same year in which it is planted, and the yield of the maize is not affected. The following results in a trial of this method were obtained at the Agricultural Experiment Station, Salisbury:—

Method of Planting.	Yield per acre. Tubers.	Vines.
4th February, 1925 (under maize)	23,520lbs.	17,103lbs.
21st December, 1925	7,572lbs.	17,504lbs.

Planting should always be done in moist soil, and when rain following planting is likely.

S.D.T.

MYCOLOGICAL NOTES

Seasonal Notes on Tobacco Diseases

10. PRECAUTIONARY METHODS IN SEED-BEEDS.

By J. C. F. Hopkins, D.Sc., (Lond.), A.I.C.T.A.,
Senior Plant Pathologist.

Now that seed-beds are being prepared, it is time to see that arrangements are satisfactory for taking all precautions against invasion by diseases. No matter what phase of tobacco culture happens to attract popular fancy from time to time, there can be no relaxation of the routine methods of disease control in seed-beds, if it is desired to reap a clean crop.

Practically all the methods employed are aimed at preventing the access of bacteria and fungus spores to the young plants, so that the first precaution necessary is to destroy as far as possible all sources of infection. It is usual to clean up or change the seed-bed site and to sterilise the soil by burning, but many growers neglect to destroy all refuse from the previous season's crop. Particularly does this apply to the primings which are frequently carried from the lands and deposited in heaps in the surrounding veld. These primings are nearly always infected by Frog Eye and frequently by *Alternaria* and remain as a source of contamination as long as they are in evidence. Dessication by the sun does not destroy the fungus in the abandoned leaves, and experiments in the past have shown (1) that a very high percentage of Frog Eye in seed-beds can arise from air-borne infection.

The next consideration is the new seed. Nearly every grower now has his seed cleaned and treated, but the degree of cleaning has a marked effect on the incidence of disease in the subsequent crop. Seed should be so cleaned that only the heaviest, which will give a high percentage germination (over

90 per cent.), is retained. It may then be sown thinly with confidence, knowing that a full stand of vigorous seedlings will be obtained. Such an arrangement does away with the necessity of thinning out and hence reduces the chances of picking up mosaic from the boys' hands. Furthermore, in a well spaced bed, few or no plants are likely to become yellow through malnutrition or overcrowding, and so become susceptible to Frog Eye.

As a further precaution, sterilisation of seed-bed cloth is recommended. Standard recommendations are the use of formalin or hot water. The former in this Colony is expensive, so that boiling in water for a quarter of an hour or treatment in a closed-in steam box are two methods generally found to be satisfactory.

Although every effort be made to eliminate all sources of infection from a previous crop, yet it cannot be guaranteed that this has been accomplished with complete success, especially in districts where large acreages of tobacco are grown on nearly all farms.

As a final precaution, therefore, it is recommended that the young plants be sprayed regularly with Bordeaux mixture at summer strength (4-4-50), for experience has shown that beds can be kept entirely disease-free if spraying is carried out correctly.

The success of spraying depends largely on the efficient working of the spray pump, therefore it is necessary to give it a complete overhaul. First of all, the hose needs to be pressure tight and capable of standing up to another season's wear and tear. Considerably greater ease of manipulation can be obtained if a hosepipe 30 feet long be employed. This allows a whole bed (25 yards) to be sprayed without the necessity of moving the spray fluid container. Next, the nozzle. It is probable that the jet has enlarged through wear and corrosion, so that a new one is necessary. It is false economy to make do with an enlarged jet, for not only is spray material wasted, but an unsatisfactory covering of the leaves is obtained. Now for the pump itself. It should be dismantled and all wearing parts inspected. Leather washers

should be well oiled (neatsfoot oil is excellent for this purpose), brass ball valves discarded if worn, and all old packing replaced by new, well greased material. For those pumps which have fibre packing on the piston, ordinary blind cord has been found to be very serviceable if well greased.

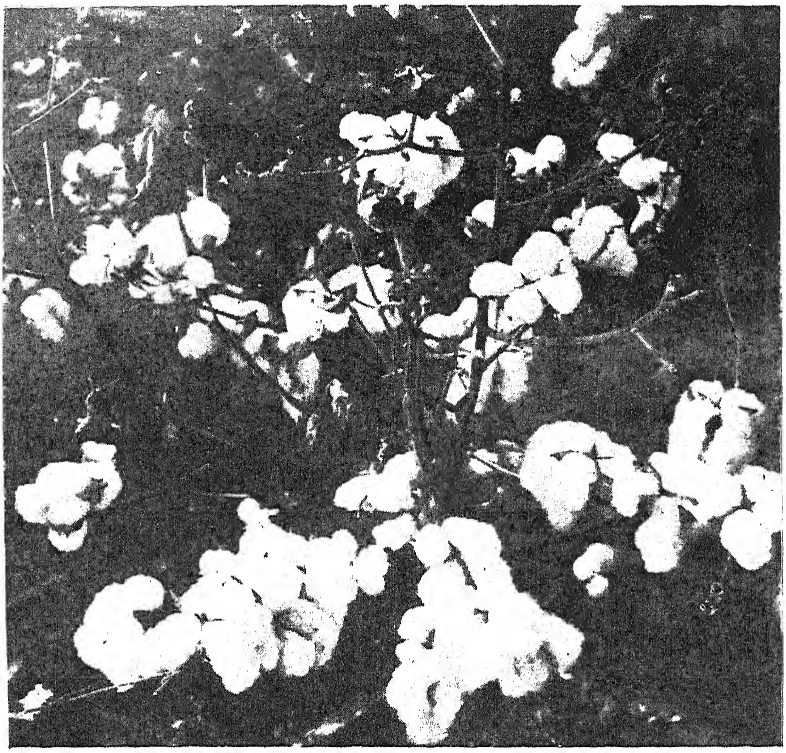
Do not delay the inspection and testing of spray pumps, because if spare parts are required, they may have to be ordered from outside the Colony, as some local merchants do not always carry adequate stocks.

Similarly, an estimate should be made of requirements of spray material and an order placed now, because there is frequently a rush of orders at the last moment and some growers do not obtain their supplies in time for the first seed-beds.

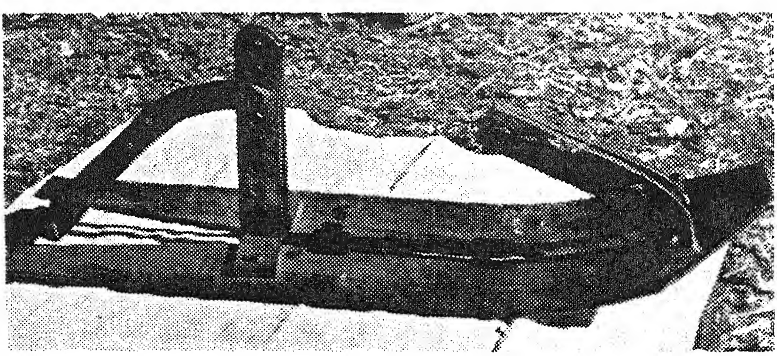
Finally, do not be mean with your spraying. Spray too frequently rather than insufficiently. Do not cease spraying when the plants are being hardened off. The cost of spraying is not high, but the results may double your income if you do the job correctly.

REFERENCE.

1. Hopkins, J. C. F.—"Seasonal Notes of Tobacco Diseases, 7, Spraying in Seed-beds and Lands." *Rhodesia Agricultural Journal* xxxi, 10, 1934.



A prolific type of Plant on the Cotton Station, Gatooma.



Depth Regulator.—One of a pair for attachment to cotton planter. Cotton seed should be planted evenly at a depth of about ½ inch. The device illustrated above assists in obtaining a good, uniform stand.

Notes from the Cotton Station Gatooma, 1937

By J. E. PEAT, Empire Cotton Growing Corporation.

Each year for the past few years short articles on cotton growing have been written for the RHODESIA AGRICULTURAL JOURNAL, setting out some of the views and ideas gained as a result of the further experience of the year. In these articles suggestions are made concerning the growing of the crop. Of necessity there is a good deal of repetition, but this is possibly not a bad thing, in stressing the more important points which year after year claim attention.

In most areas, this past season has been a favourable one. On the whole yields have been good. Where they have not been satisfactory, the fault, in many cases, has been the fault of the grower, and not, this year, the fault of the season. The faults of the season can be only partially circumvented: the faults of the grower to a large extent can be remedied.

In the suitable areas more farmers should now be growing cotton as a rotation crop. (It is granted that there are areas where for a number of reasons there are special difficulties). But, for most growers it is an entirely different proposition to-day from what it was even six or seven years ago. Seed of early maturing and heavy yielding stock is now available: and we know much more about the general handling of the crop in relation to seasons and pests. In areas that are suitable, most farmers should be growing at least a small acreage. They would then become acquainted with the crop, and it would be comparatively easy to expand should they so desire. It would not be too easy a proposition for most growers to start in straight away with a biggish acreage.

Southern Rhodesia is not a country ideally suited to the growing of cotton, but then in most cotton-growing countries there is some snag or other. Here, the season is on the short

side, making it somewhat difficult for the plant to recover after a drought period, or after insect attack. But our experience has been that in the suitable areas, over a period of years, it is a crop very worth while growing in a mixed farming scheme. There have been good years, and years not-so-good, as with other crops. At Gatooma we have been growing cotton for the past twelve seasons, and over the last period of years, since we got on to better seed stock, in our bulk planting, we have averaged very worth while crops.

There are factors to be taken into consideration other than the actual price received for the lint. There is the value of the seed for cattle feed. There is the undoubted benefit of cotton to a succeeding maize crop in a rotation. This has been very marked in the last few years on the Station where very good maize crops have been reaped on quite ordinary land with the use of very little fertiliser. And then, there is the benefit from the grazing of the plants in the field, after the crop has been picked.

Price is determined by factors quite beyond our control, mainly by the size of the American crop. This year the American crop is especially good. Yield estimates are exceptionally high, and, as a result, cotton has dropped in price over 2d. per lb. in the last few months. But as things are, the price to-day gives very little indication of what the price may be this time next year. As with crops at home, growers tend to miss the bus if they do not plant because the price is low, and plant only when the price is high, at planting time. The price at reaping may be a very different matter.

At Gatooma, this season has been the best since the Station started. Cotton, under more or less commercial conditions has been averaging around 1,000 lbs. seed cotton per acre. Smaller areas of experimental strains, and areas under special teatment, have been going higher than this. It has been a good season, but not an ideal one — (a five weeks' drought, starting in February and extending throughout most of March, caused loss, especially on the poorer lands). It was a season of early planting rains—an important point. Stands were excellent. The early part of the season was favourable for the early get-away of the crop; and most of the crop was set before the pests started to take their share.

It is interesting to discuss some of the factors which have influenced yield, and some of the mistakes which have prevented growers from getting an equally satisfactory return.

(a) Time of Planting.—If early planting rains give the opportunity, cotton should be planted *as early in November as is possible.* A delay of even a couple of weeks after suitable planting rains have fallen, may make a considerable difference to the yield. This happened to a number of growers this season who, despite early planting rains, planted later than was advisable for optimum results. This difference is caused partly by the timing of insect attack, and partly by the strain to a young crop of the drought periods in February and March. If a grower either because of late planting rains, or because of some other factor, cannot get his cotton crop planted by at least the second week in December, in the majority of years it would pay him to reduce his cotton acreage for that year and to plant maize instead. It follows from above, that, during the growth of the crop, factors which make for satisfactory early progress are factors favouring ultimate yield—such factors as early thinning, and early cleaning.

(b) Planting.—*"STAND" is probably the most important factor affecting final yield, which at the very start can be influenced by the grower.* A good stand is of the greatest importance. It is scarcely possible to over-emphasise this. This past season a number of growers, who should have had satisfactory yields, failed to do so because of the poorness of their stands. And other growers whose crops at a casual inspection appeared quite ordinary, reaped out surprisingly well because of the excellence of the stands.

At planting, probably the most important factor determining stand is depth of planting. The seed should not be buried more than half an inch or so, and to this end, if planting is done by machine, it is almost essential to fit the planter with "shoes," to prevent it, in some parts of the land, planting too deeply. These planter "shoes"—an illustration of which accompanies this article—can be bought through Salisbury and Bulawayo implement dealers at a cost of 10s. to 20s. a pair.

It is worth while, with machine planting, to use a fairly heavy seed rate, 25 to 30 lbs. an acre, to ensure a good stand. The result of heavy seeding is a breaking of the crust, if a crust should form just after germination.

All seed sold from the Bindura Ginnery (which is now under the control of the Cotton Research and Industry Board) is tested for soundness, and in most years only seed above 60 per cent. soundness is sold as seed. (This soundness, of course, is quite independent of strain type. Unsoundness in seed is caused, mainly, by stainer damage, or by immaturity, owing to the plants having suffered through droughting, while the bolls were developing). It stands to reason that with hand planting, where clumps of seed are planted at 6in. to 12in. in the line, a lower seed rate may be employed. On the Station, where valuable seed is being handled, with careful treatment good stands are obtained with comparatively light seed rates. *But for the ordinary grower it is poor economy to stint the seed rate.*

(c) Seed Supply.—There is now available, through the Ginnery at Bindura, seed of good yielding stock, which has been well tested out throughout the country in the last few years. The strains now being issued — G.5.123, G.5.79, G.5.30—are all derivatives of the old U4/64 bred up at Gatooma from the original U4. There will be no fresh issue of seed from Gatooma this year, nor probably will there be any issue next year. When such seed is available for issue the main improvement will be increased jassid resistance. (In passing it might be mentioned that in 1936 a few small areas of cotton suffered somewhat from jassid, although the majority of the crop did not. The past season no crops were seen showing serious jassid damage.)

(d) Soil and Fertility.—Like most other crops, cotton can be grown successfully on a fair range of soils in this country—both red loams and granite soils. But is has become increasingly evident that, for really satisfactory results, land with a certain amount of "guts" is essential. On poorish land poorish growth is to be expected, and, unless a reasonable framework can be made, it is impossible to carry a heavy crop. If land is not naturally in good heart, humus has to be added. In a recent article A. G. Street quotes a Norfolk farmer as

saying: "You can't farm without muck," and it appears to the writer that this applies also to most of Rhodesia, and that what so many farms in this country require is MUCK.

On the Station, this year, very striking increases in cotton yields have been obtained by the application of Indore compost, made during the rains, after feeding oxen through the dry season on crop residues, mainly mealie stalks and sunn hemp hay. The process is comparatively simple, and has been described in detail by Timson in a number of articles in this JOURNAL. The main labour lies in the carting of crop residues to suitable centres, for feeding, and for making the compost. But all this is largely a matter of organisation for each farm.

This year on the Station a dressing of 5 tons per acre had the effect of doubling, very nearly, the yield of seed cotton. On the poorish piece of land on which the test was made, the untreated area was yielding just over 500 lbs. seed cotton per acre (there was a five weeks' drought period, February into March): the 5 tons per acre dressing gave over 900 lbs. seed cotton per acre: the 10 tons per acre dressing round 1,100 lbs. seed cotton per acre, while the 20 tons per acre dressing gave nearly 1,300 lbs. seed cotton to the acre. It might be mentioned, however, that very good yields were obtained on another portion of the Station—friable red land in good heart—which received no compost, but this area got a rain in March which the other area did not.

This coming season, compost will be tested out again on the Station on a commercial scale, and different rates of application will be compared in trials. If the results come up to expectation, there will have to be a considerable change in the economy of the Station, directed towards the making each year of as much compost as is practicable.

In the same way, a growth of the practice of composting on farms will affect the economy of many. Farming will tend to become more intensive. There will have to be a growing of crops for composting, and a collection of plant residues. Linked up with this will be an increase in the feeding of stock to obtain the necessary quantities of dung.

The general experience of the last few years has been that it is not economically worth while to fertilise red loam land directly with supers for cotton crop. This has also been the experience around Barberton. But, cotton does respond to the residual effect of a fertilised previous crop, such as tobacco. Some very good crops of cotton have been taken off land following fertilised tobacco, and maize. (There are certain difficulties connected with the maturing of the crop, and with stainer and American Bollworm damage affecting cotton grown on exceptionally rich land or land exceptionally rich in nitrogen. But this would apply to but a very small proportion of the available land in Southern Rhodesia.)

While it is not economically worth while to fertilise directly for cotton on red loam, it may be worth while on granite soils. Recent work at Barberton on granite soils, has shown good increases from an application of 200 lbs. Super-Phosphate to the acre; and very good increases from a top dressing at thinning of 200 lbs. Nitrate of Soda to the acre. But probably the Nitrogen could be applied more economically through compost. Tests on granite soils will be made this coming year in this country.

(e) Cultivation and Spacing.—As has been mentioned earlier, it is important to help the plant to make an early get-away. In this connection it is necessary only to mention the importance of good ploughing. The early cleanings and cultivations are the important ones. A crop choked by weeds in the early stage receives a considerable setback. In the same way, thinning should not be left too late. The plants should be thinned about a month to five weeks after planting, when the plants are getting into their second and third leaf, and are about four to six inches high.

Rows are normally 3ft. to 3ft. 6in. apart, and on most soils plants should be thinned out to one plant to a hill with anything from 6in. to 12in. between hills. Where there are gaps, two or three plants should be left to a hill. It is unwise to space closer than about 6in., as the plants, if packed together, suffer during drought periods. On the other hand, on most moderate soils, a spacing wider than about 12in. means reduced yield. In this country, with our comparatively short growing season, the plant does not appear to be

able to take advantage of the greater space given to it. On richer land, however, the plant can respond to a wider spacing; and it is possible that should composting become a general practice that the intra-row spacing will have to be increased.

(f) Picking.—While it is not economical to pick too soon after the first bolls start opening, it is a mistake to leave the crop too long on the plants before beginning to pick. The longer the cotton remains on the plants the more dirty does it become, and the more difficult it is to pick per day a good weight of reasonably clean cotton. It should be possible, with a fair crop, to pick about 40 to 50 lbs. of seed cotton per boy per day: the better boys will exceed this. In the first picking, badly strained and immature cotton should not be included. It was noticed this year that some of the new native growers had mixed badly strained cotton in with good clean cotton, thus reducing the value of the whole sample.

(g) Insect Pests.—*Bollworms*: The two bollworms in Southern Rhodesia are the American Bollworm, and the Red or Sudan Bollworm.

American Bollworm.—This year as a result of early planting rains, and the good season, the plants had developed a good crop of well-formed bolls before American Bollworm egg-laying started seriously. As a result it has been a year of comparatively light American Bollworm damage. But this pest is one of the most serious obstacles to successful cotton growing in this country, and a considerable amount of work is being devoted to the study of the American Bollworm position in Southern Africa. As has been shown again this year, factors making for the early development of the crop are factors reducing the amount of damage.

As has been described in fair detail in some of the earlier articles, crops other than cotton, if at the budding and the flowering stage, attract the egg-laying of the American Bollworm moths, and thus help the position as far as the cotton crop is concerned. This year's work at the Station has shown the marked attractiveness of early planted Dolichos Beans. The period for which cover is desired in mid-February to early March.

It is probable that in the ordinary course of events American Bollworm will not be as serious a pest for the native growers as it is for the European growers, because of the lesser attractiveness of the small acreages of cotton that they will be growing, because of the competing attractiveness of the areas of other crops nearby, and the probability that there will not be present in the first place the large American Bollworm moth population that must be present in most of the old-established maize-growing areas.

Red or Sudan Bollworm.—During this past season the Cotton Pest Prevention Act became law. The passing of this measure is of much more importance than probably the majority of growers realises. Simply, it is a measure to ensure that there will be each season a close period, during which no cotton will be growing to provide food and a breeding-up ground for Red Bollworms and Stainers. In so far as the Red Bollworm position is concerned, it is anticipated that, in most areas in the country, this measure will reduce Red Bollworm to the position of a minor pest. This year the 1st of October is the date under the Act by which all growing cotton must have been destroyed.

(h) Stainers.—More noticeably this year than in the past year or two, a number of crops have been seen seriously reduced by Stainer damage—a part of which at any rate is preventable. Some of these were crops well-grown and laden with bolls—crops that would have yielded very heavily indeed had it not been for this Stainer damage. (In passing it might be pointed out that staining is more than a mere discolouration of the lint, and of the seed. In a bad attack many of the young bolls never reach maturity, and with the more developed bolls opening is very bad.) It is highly probable that this damage had been caused in these annual crops by Stainers flighting in from ratooned or stand-over crops in the area. Recent work at Barberton has shown that adult Stainers may fly at least 16 miles from one cotton crop of host plants to another, and it is known that at a certain stage in the life of a ratooned or stand-over crop the adult Stainer prefers to fly out of it to an attractive annual crop, even to some considerable distance away. Thus, in the past, it

has not only been the man who ratooned or who left his crop "stand-over" from one season to the next, who suffered, but the entire area in which that ratooned or stand-over crop was.

That portion of Stainer damage, due to ratooning and stand-over cotton, will now be prevented by the Cotton Pest Prevention Act, and the prevention of this damage will be to the grower the most important immediate effect of the Act.

In conclusion, it is the view of the writer that it is a mistake to plant cotton at all unless the grower is prepared to give it a chance, and to treat the crop at least half seriously. There are no special difficulties about growing it. It should be planted as early as the planting rains will allow, and not too deeply, on land at least in moderately good heart. Every encouragement should be given to it, by early cultivation, thinning and weeding, to get away — an early start is half the battle.

In so far as the grower can affect it, the fate of the crop is largely determined by the type of land, the date and style of planting, the seed, and his treatment of the crop during the first few weeks. After that the possible yield is affected mainly by factors beyond his control—the distribution of the rains, what drought periods may occur in February and March, and the seriousness, or otherwise, of insect attack.

Report on Fire-cured Tobacco Experiments, 1936-37.

By C. E. Strickland, B.Sc. Agric.
Lion's Den, Shamva.

Although the season 1936-37 has not been fortunate in the matter of both weather conditions and pests, the results obtained from the experiments are not without interest. The scheme of experiments followed the lines of those last year with slight modifications. Thus the fertiliser experiment with different quantities of potash was repeated, using Little Crittenden variety planted early as before.

The experiment with nitrogen fertiliser in different forms using Western variety, was also repeated.

Distance planting with both Little Crittenden and Western was carried out on a rather larger scale.

Finally the number of varieties was reduced, only sufficient plots being grown for seed selection.

Potash.—Sixteen ¼-acre plots were arranged as follows:

A. (4 plots) received no potash.

B. ,, received 50lbs. per acre of a mixture of equal parts muriate and sulphate of potash.

C. ,, received 100lbs. per acre of the same mixture.

D. ,, received 150lbs. per acre.

All the plots also received a dressing of 150lbs. per acre of Superphosphate and 75lbs. per acre of sulphate of ammonia. The plots were planted with Little Crittenden on December 15th under favourable weather conditions; seedlings were strong and healthy and an almost perfect stand was obtained. The plants grew without any check and up

to the end of January looked like yielding a very fine crop. As was the case last year no difference in any particular between the plots could be noticed in the field. The only disease which appeared up to this stage was curly leaf amongst a few plants. There was no mosaic. At the end of January a week of excessively heavy rains and violent wind-storms occurred which did much damage by knocking down and breaking off plants.

Early in February spot began to appear as happened last year and developed rapidly until the whole crop was covered and ruined. There was also an increase in curly leaf. In spite of this very heavy yields were obtained as will be seen in the following table.

The leaves grew to an enormous size, much larger than is required by the market. Eight leaves only had been left to a plant, and it is clear that a larger number could have been carried with advantage. In spite of damage by wind and disease the following yields were obtained:—

A.	B.	C.	D.
No potash.	50lbs. p.a. potash mixture.	100lbs. p.a.	150lbs.
897lbs.	1081lbs. p.a.	980lbs. p.a.	978lbs. p.a.

These results largely confirm those of last year, and the indication is that there is little advantage in applying more than 50 lbs. per acre of the usual Potash fertilisers to the red soils of the Shamva district.

Although in the previous year the C plots gave a slightly better yield than the B plots the difference was not sufficient to warrant any definite conclusion, and is offset by the reverse position this year.

Further, it seems that the mixture as applied to the B plots, 150lbs. per acre Superphosphate, 50lbs. Sulphate of Ammonia and 50lbs. mixture of Muriate and Sulphate of Potash, is thoroughly satisfactory and economic. The equivalent quantity of Muriate or Sulphate had it been used alone would be 45lbs. and 55½lbs. respectively, but such exactness for field purposes is unnecessary. One may imagine an increase on the above already high yields, had conditions remained favourable throughout, and more leaves

left to a plant. The cost of this mixture is approximately 18s. 5d. per acre at present prices in Salisbury. The writer believes that many growers are accustomed to apply heavy dressings of ready mixed complete fertilisers which add greatly to the expense per acre without providing any corresponding advantage. Only 200lbs. per acre, for instance of a commonly used fertiliser would cost at present price, 24s. per acre.

Although there is a right and a wrong way of mixing fertilisers on the farm, there is no great difficulty about it, and although the mixing can never be as thorough as when done by machinery if done properly it will be adequate. So far the effect of Potash has only been considered in relation to the yield. What of quality?

Owing to disease the whole crop was reduced to the same level commercially, but it was possible for the purpose of the experiment to grade into what might have been wrapper, and what would have been of poor quality in any case, and also into sizes.

The following table shows the result in percentages of the yield of each group:—

	A.	B.	C.	D.
(1) Long Wrapper over 22in. ...	27%	26%	25.5%	17%
(2) Long Wrapper over 22in. ...	23%	27%	37 %	29%
(3) Short Wrapper 18-22in.	18%	12%	8 %	6%
(4) Poor quality	32%	35%	29.5%	48%

Considering the figures as a whole there does not seem to be any marked advantage by applying the higher quantities, and it is noticeable that the plots receiving no potash compare favourably with the others.

One other point, which stands out conspicuously and agrees with the experiences of last year, is that there is considerable risk of disease where Little Crittenden is used for early planting, while its earlier ripening qualities as shown wherever it has been planted at the same time as Western, make it a valuable variety where late planting has to be carried out. When too these two varieties have been planted

at the same time in the first half of the season Little Crittenden compares unfavourably with Western as regards disease resistance.

Distance Planting.—This year instead of a few lines of each planting distance 12 $\frac{1}{4}$-acre plots were planted, half with Little Crittenden, half with Western, at distances of 2ft., 2ft. 6in. and 3ft. in the rows, the latter being 3ft. apart. For each variety there were thus two plots with plants 2ft. apart, two plots with plants 2ft. 6in. apart and two with plants 3ft. apart.

The plots were planted on December 28th under fairly good weather conditions, but a hot dry week followed, and a rather poor start was obtained, the Little Crittenden, which seems to be hardier at this stage being a good deal better than the Western. For this experiment it is of course particularly essential to obtain a good stand, and it was therefore the more unfortunate that the plots suffered seriously from the storms at the end of January, and also a severe attack of eel worm, which resulted in the leaves being very small throughout.

Spot also developed very badly in February as on the Potash plots, but only the Little Crittenden was affected. Western planted alongside were practically untouched. From all these causes a very poor yield resulted, compared with the yield from the Potash plots, a fact which largely discounted the value of the experiment.

The Little Crittenden was ready for the first picking on April 1st and was finished on April 19th, the first Western was not ready till April 24th, so that the former showed a gain in maturing of $3\frac{1}{2}$ weeks.

The results obtained were as follows:—

	2ft.	2ft. 6in.	3ft.
L. Crittenden	752lbs. p.a.	666lbs. p.a.	580lbs. p.a.
Western	650lbs. p.a.	540lbs. p.a.	560lbs. p.a.

It is rather surprising to find Little Crittenden giving a heavier return than the Western, a fact which can probably be accounted for by the much better stand of the former.

In both varieties the leaf was small, mostly under 22in. in length, while there was a good deal of very short leaf under 18in. Except in the case of the Western planted 2ft. apart there was no great difference between the plots as regards the quality of this very short leaf, which was probably chiefly due to the lack of development owing to eel worm. Last year there was none of this even in the 2ft. plots, all the leaf having grown to a great size.

Nor considering the results as a whole, was it found that the wider planting distances gave any marked improvement in quality. The following tables give the figures for the two ¼-acre plots of each variety at each planting distance.

LITTLE CRITTENDEN.

	2ft.	2ft. 6in.	3ft.
Wrapper over 22in.	22lbs.	54lbs.	56lbs.
Wrapper 18-22in.	141lbs.	136lbs.	125lbs.
Under 18in. good quality	37lbs.	27lbs.	23lbs.
Low quality	176lbs.	116lbs.	86lbs.
TOTAL	376lbs.	333lbs.	290lbs.

WESTERN.

	2ft.	2ft. 6in.	3ft.
Wrapper over 22in.	37lbs.	24lbs.	34lbs.
Wrapper 18-22in.	154lbs.	91lbs.	77lbs.
Under 18in. good quality.	60lbs.	36lbs.	14lbs.
Low quality	74lbs.	119lbs.	155lbs.
TOTAL	325lbs.	270lbs.	280lbs.

Although for reasons given above too much reliance can not be placed on these results, the indications are, as was the case also last year, that much closer planting than has been practised in the past is probably advantageous. A further experiment on these lines should be worth while.

Nitrogen Experiment.—This again was a repetition of last year's experiment, the variety planted being Western. Sixteen ¼-acre plots were given a uniform dressing of 150lbs. Superphosphate, and 50lbs. Potash mixture per acre.

Four plots (A) received no nitrogen.

" " (C) received an equivalent quantity in the form of bloodmeal.

" " (B) received 100lbs. per acre of Sulphate of Ammonia.

" " (D) received an equivalent quantity of nitrogen, half in the form of Sulphate of Ammonia, half as bloodmeal.

The plots were planted on the 23rd of January and again owing to dry weather following a poor stand was obtained. Very heavy rains came a week later, and the water was standing on the land for several days. The plots were gapped up twice during the first week in February, and eventually a fair stand resulted. After the middle of February, however, very few rains of much value occurred, and as these plots were on rather poor clay soil, plants made very poor growth, and the yield throughout was small. Curly leaf again was troublesome, but there was no spot or mosaic.

It was noticeable that during the period of unfavourable weather which these plots suffered, the B and D plots, i.e., those which received Sulphate of Ammonia, looked better throughout. The stand was better, the plants looked healthier, started to grow more quickly, as as will be seen, eventually gave a better yield. The advantage of the comparatively rapid availability of the nitrogen in Sulphate of Ammonia, compared with that contained in Bloodmeal, for which conditions for rapid nitrification were absent, was thus clearly shown. The yields obtained were:—

A. No nitrogen	B. 100lbs. S. of Ammonia	C. Bloodmeal	D. Half sul. and half bloodmeal
367lbs. p.a.	488lbs. p.a.	383lbs. p.a.	507lbs. p.a.

It will thus be seen that the plots receiving no nitrogen and those receiving it as bloodmeal only were practically identical, while those receiving nitrogen from sulphate only and from the mixture were also about the same.

The D plots, although having received only half the quantity of nitrogen from sulphate that the B plots did, were probably, owing to their more rapid growth and greater size of plants, able to make greater use than the C plots of such nitrogen as became available from the bloodmeal in the latter part of the growing season. There is no apparent reason, why the more expensive bloodmeal should be used in place of sulphate of ammonia, apart from the consideration of any residual value there may be from the former.

As regards the quality of the leaf from these plots, owing to the early cessation of the rains, and the poor growth of the plants, it was necessary to prune much lower than would otherwise have been done, in order to get any reasonable return. Quality was therefore poor. Such wrapper as there was was chiefly 18in. to 22in. in length and again the B plot and D plot showed to some advantage.

Wrapper	A.	B.	C.	D.
18-22in.	128lbs.	141lbs.	101lbs.	175lbs.

There remain to be mentioned a few plots grown for seed selection.

Little Crittenden.—A half acre plot was planted on the same day as the Western on the nitrogen plots, and, as has been said, this variety seems better able to withstand hot dry weather after planting, since an almost perfect stand was obtained. It was quite uniform and true to type. There was an improvement on last year as regards ratio of width to length, and fewer narrow very tapering leaves. The leaves were rather small, however, owing to the short growing season.

Western.—A half acre plot of this variety, and another half acre plot of Little Crittenden were planted on February 6th side by side. The latter gave a good stand, and grew away well. The plants did not attain much size, and were harvested on the 13th May. The former on the other hand gave a poor stand, was slow to get away, and was not ready for harvesting till 28th May. Some good seed plants were obtained.

Western x Little Crittenden.—It was intended to plant a half-acre plot of this cross from seed selected last year for its intermediate qualities and also a half-acre of One-sucker. For various reasons it was not possible to do this, and a few lines only of each were planted as late as the 23rd February.

The Western x Little Crittenden cross was very much more uniform than last year, and a large proportion of plants of intermediate type were evident. Little Crittenden seemed to have practically disappeared, and the remainder tended towards the Western type. Those of intermediate type looked very promising in the field as regards shape, size, and texture, but the frost unfortunately prevented any being cured. A fair amount of seed was, however, obtained.

One-Sucker.—This variety planted the same day was unwilling to grow at all, but eventually produced a few good plants from which seed was obtained. The seed was not acclimatised, otherwise better results might have been obtained.

GREEN MANURING

Two Important Factors Affecting Success

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and

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I. The effect of the date of ploughing under of the green crop on the yield of the following maize crop.—Up to the present the chief factor considered by farmers when deciding on the date of ploughing under of the green-manure crop has been the stage of maturity reached, apart from the question of whether the soil is dry enough to permit it.

The importance of the date of ploughing it in has not been generally taken into consideration, except that it has been thought, of course, that it is desirable to plough the crop under whilst there is sufficient moisture in the crop and the soil, or likely to fall later in the form of rain, to enable the micro-organisms in the soil to complete the rotting of the crop before the advent of the following planting season. In this Colony, of course, the six to seven months of winter are practically devoid of rain, and only very exceptionally does a fall occur then, sufficiently heavy to penetrate the soil and influence the rotting of organic matter buried by the plough.

A number of striking cases have come to notice during the past eight years, however, where the maize crop following green manure has shown little or no benefit, although the growth of the green crop has been excellent, the crop well covered by the plough, and thoroughly rotted before the planting of the maize. In some extreme cases the maize crop has exhibited marked nitrogen deficiency in the soil by its yellow foliage and poor growth.

In practically all these cases investigation has shown that the green crop has been ploughed under in late February or early March, and that a considerable quantity of rain has fallen after ploughing in the green crop, and previous to the germination of the following maize crop.

The theory was formed that the poor manurial effect of the green-manure in all these cases was due to the leaching from the soil of much of the nitrogen in the rotted green-manure by the rain; owing to the early mineralisation of the organic nitrogen, that is to say its conversion from the insoluble organic to the soluble nitrate form, by the action of the soil micro-organisms.

McChlery (1) found that at the time of ploughing under the green-manure the soil contained practically no nitrogen in the soluble nitrate form. This was confirmed by subsequent investigation of which the results have not yet been published. He further found that where a sunn hemp crop 12 weeks' old was ploughed in, mineralisation of the organic nitrogen in the sunn hemp was rapid, as shown by a definite increase in the nitrate within one week from the date of ploughing under.

It appears to be clear therefore that leaching of the nitrogen from a sunn hemp green-manure crop by rain may commence within one week from the date of ploughing it under providing it is not too mature.

Experimental.—In November, 1935, an experiment was laid down on the Agricultural Experiment Station at Salisbury, with the object of demonstrating the effect of the date of ploughing under the sunn hemp green-manure crop on the yield of the following maize crop.

It was designed in the form of randomised blocks occupying two acres. The size of each plot was 1/20 acre, and each treatment was replicated 8 times. Five different dates of ploughing under of the crop were selected commencing with 21st February, 1936; the others following at fortnightly intervals. The dates of sowing were adjusted so that the sunn hemp in each case was as nearly as possible the same age at the time it was ploughed in, viz., approximately 14 weeks.

Eight plots of sunn hemp were, therefore, ploughed under on each of the five dates.

No fertiliser was applied and the maize crop was sown on the 29th November, 1936. The results obtained are tabulated below:—

SEASON 1935-36.		SEASON 1936-37.	
Dates of sowing sunn hemp.	Dates of ploughing sunn hemp.	Yield of maize following sunn hemp, in bags of 200lbs. each, per acre.	Percentage increases in yield of maize due to later date of ploughing in sunn hemp.
Nov. 15th	Feb. 21st	14.22	100
Dec. 1st	Mar. 7th	15.36	108.08
Dec. 15th	Mar. 21st	16.75	117.78
Dec. 31st	Apl. 6th	17.56	123.41
Jan. 15th	Apl. 21st	17.75	124.89

The rainfall during the period following the first date of ploughing in of the sunn hemp, and before the sowing of the maize is given in the following tables.

Dates 1936	25-2	26-2	27-2	28-2	1-3	2-3	3-3	4-3	5-3	6-3
Rainfall in ins.	0.03	0.26	0.02	1.40	0.23	0.47	0.71	0.24	0.67	0.45

Dates 1936.	7-3	8-3	12-3	13-3	14-3	16-3	17-3	20-3	24.3	27-3	31-3
Rainfall in ins.	0.48	0.04	0.28	0.02	0.11	0.31	0.62	0.11	0.05	0.06	0.59

The rainfall during April, 1936, was negligible save for a fall of .30 inches on the 18th. During the period May to September the rainfall was negligible, amounting in all to .26 inches, of which the highest on any one day was 0.16 inches.

RAINFALL—OCTOBER TO NOVEMBER.

Dates 1936	7-10	15-10	19-10	23-10	27-10	31-10	1-11	13-11	15-11	16-11
Rainfall in ins.	0.32	0.75	0.20	0.20	0.03	0.14	0.34	0.25	0.01	0.45

Dates 1936	19-11	22-11	23-11	24-11	25-11	26-11	27-11	28-11
Rainfall in ins.	0.50	1.60	0.07	0.26	0.35	0.65	0.01	0.01

Discussion.—It will be seen that the date of ploughing under the sunn hemp crop has affected the yield of the following maize crop considerably. The maize following sunn hemp ploughed in on the 21st April has given practically a 25 per cent. increase in yield over that of maize following sunn hemp ploughed under on the 21st February. The difference between the two yields was 3.53 bags per acre.

During the period 21st February to the 21st April, 7.45 inches of rain fell.

It is thought that the 25 per cent. difference in yield brought about by the differing dates of ploughing under of the sunn hemp, has been largely due to the leaching by this 7.45 inches of rain of plant foods, chiefly nitrates, from the soil. It may be presumed that those showers during which less than 0.2 inches fell had no leaching effect, so that 7.01 inches is probably the total effective rainfall during the period.

As evidence in support of this theory it may be pointed out that the rainfall between April 6th and April 21st was only 0.30 inches, and the difference in yield of maize due to this difference in the date of ploughing under the sunn hemp crop was only 0.19 bag.

The leaching effect of the 8.28 inches of rain which fell between the dates 7th October, 1936 and 28th November, 1936, has presumably been common to the sunn hemp ploughed under on all five dates. It is probable, however, that nitrification of the sunn hemp ploughed under in the dry soil on 21st April, 1935, had not advanced very far before 7th October, 1936, and for that reason leaching of the nitrates from it would not be so extensive as in the case of the sunn hemp ploughed under on previous dates.

No claim is made that the experimental results yield definite proof of the theory that the differences in yield of the maize are due to the leaching of nitrates by the rain subsequent to ploughing under of the green crop. This is, however, advanced as a theory to explain these results. The authors have not lost sight of the fact that the differing climatic conditions during the growth of the sunn hemp

ploughed under at successive dates may be a factor, which may have influenced the yield of the following maize crop; but they are of the opinion that this is of minor importance.

It is also possible that the almost complete absence of nitrates in the soil observed by McChlery [1] at the time of ploughing under the sunn hemp on the last two dates (April 6th and 21st) having persisted through the rainless winter, assisted the activity of the nitrogen fixing bacteria after the first effective spring rains, in combination with the aeration of the soil, brought about by the preparatory cultivation before planting. However, these conditions could hardly persist for long, since the nitrification of the sunn hemp would lead to a rapid production of nitrate.

Conclusion.—*It is demonstrated that the date of ploughing in of a green-manure crop such as sunn hemp materially affects the yield of the following maize crop. Farmers are therefore advised to either sow the sunn hemp crop rather later than is normal, or to delay the ploughing in to a rather later date than is usual now.* Since the former does not suit farm organisation so well in the maize belt, it would appear that the latter is more suitable.

Most of the sunn hemp in the maize belt of the Colony is sown in dry soil before the main planting rains in spring. This means that much of it is ready for ploughing under in late February to mid-March. If it is ploughed under during this period it is clear that much of the benefit to the following maize crop may be lost, and the yield of the maize may be reduced by two to three bags per acre.

Furthermore, much damage to the tilth of the heavy soils of the maize belt is being caused each year by ploughing in green-manure when the soil is still moist, and this would largely be avoided by postponing the date of ploughing under.

It is necessary, however, to point out that there is the danger of loss if the green crop is ploughed under in too mature a condition or too late in the season, since the rotting process may not have proceeded far enough, or the sunn hemp may have so low a nitrogen content that the micro-organisms have to draw on the nitrate supplies in the soil,

before the planting of the following maize crop, and thus the latter may suffer a check during the early stages of its growth.

It is considered that if the sunn hemp crop is germinated in mid-November, it may normally be safely ploughed under in mid-March. *In order to avoid the loss of nitrogen from the green-manure, maize following it should be planted as early as possible so that it can take up the available nitrates, and prevent their loss from the soil by leaching.*

Finally it is necessary to point out that the continuance of the seasonal rains to the end of March is somewhat abnormal, and for that reason the results of this experiment cannot be applied literally to farm practice. For instance, had the rains more normally ceased about mid-March, it is probable that the last two dates of ploughing under the sunn hemp might have yielded a less beneficial effect on the maize crop, for various reasons already mentioned.

II. The effect of the rate of Seeding the Sunn Hemp crop on its Manurial Value.—A series of experiments carried out over the period 1926 to 1930 ([2]) demonstrated that the difference in manurial value of the whole crop ploughed under and that of the stubble only, was much less in the case of sunn hemp than in that of velvet beans or dolichos beans. With sunn hemp this difference, as measured by the yield of the following maize crop was 0.99 bags per acre; with velvet beans 2.81 bags per acre; and with dolichos beans 1.9 bags per acre.

To explain this, the theory was suggested that the much denser stand of plants in the sunn hemp crop supplies to the soil a much greater quantity of humus, and perhaps of nitrogen fixed from the air by the root bacteria, by the decay of its root system than in the case of the other two crops, which are much more widely spaced.

This led to the further suggestion that an increase in the seeding rate of sunn hemp might increase the manurial value of both the whole crop and of the stubble alone.

Experimental.—An experiment was therefore designed to investigate this. The experiment was laid down in five randomised blocks of four plots, each of one tenth of an acre in size.

On these five blocks sunn hemp (Somerset strain) was sown at four different rates, namely: (1) 20lbs. per acre; (2) 40lbs. per acre; (3) 60lbs. per acre; and (4) 80lbs. per acre. On each main plot was imposed three sub-treatments, namely: (a) ploughing under the whole crop at the normal stage of growth for green-manuring; (b) removal of top growth and ploughing under the stubble only; this being done when the crop was at the same stage of growth as in sub-treatment (a); and (c) removal of mature top growth, and ploughing under of mature stubble only.

The sunn hemp was sown on 6th December, 1935. Sub-treatment (a) was carried out on 17th March, 1936, and sub-treatment (b) on 28th March, 1936, after the removal of the top growth on 17th March, 1936. Sub-treatment (c) was carried out in July, 1936. The maize crop was sown over the whole area of two acres on 29th November, 1936.

The rainfall during the period of the experiment is shown in the tables above. The results are tabulated below.

TABLE I.

Treatments: Rate of seeding per acre.	Yields of maize in bags per acre.	Percentage increase in yield of maize due to increased rate of seeding of sunn hemp.
(1) 20lbs. p.a.	15.90	100.00
(2) 40lbs. p.a.	16.83	105.84
(3) 60lbs. p.a.	17.77	111.12
(4) 80lbs. p.a.	16.24	102.20

No furtiliser was applied.

TABLE II.

Treatments: Rate of seeding per acre.	(a) Whole crop ploughed under.	(b) Immature stubble only ploughed under.	Mature stubble only ploughed under.
(1) 20lbs. p.a.	17.37 bags p.a.	16.56 bags p.a.	13.77
(2) 40lbs. p.a.	19.47 bags p.a.	15.87 bags p.a.	15.15
(3) 60lbs. p.a.	18.89 bags p.a.	18.12 bags p.a.	15.30
(4) 80lbs. p.a.	18.09 bags p.a.	16.50 bags p.a.	14.13
Average yields of maize p.a.	18.70 bags p.a.	16.76 bags p.a.	14.58

Discussion.—In Table I the yields of maize given are the average yields of 15 sub-plots under each main treatment. They therefore also include the effect of the sub-treatments.

It will be seen that the increase in the rates of seeding of the sunn hemp have given a fairly regular increase in the yield of the following maize crop up to the 60lbs. per acre rate of seeding. The 80lbs. per acre rate of seeding has reduced the yield of maize compared with 60lbs. per acre. It is thought that this is due to the drought during the growth of the sunn hemp in Decemebr and January having a greater effect at this very high rate of seeding.

In Table II it will be seen that the same increase in yield of maize due to the increased rate of seeding of sunn hemp is shown all through the three sub-treatments. In the case of sub-treatment (b) however, the increase in seeding rate from 20 to 40lbs. per acre shows a fall in the yield of maize. It is thought that this is probably due to chance alone, owing to the variation in soil fertility.

With regard to the sub-treatments, it will be seen that the yield of maize after the whole crop has exceeded the immature stubble by 1.95 bags per acre. This figure is greater by 0.58 bags than the highest difference between these treatments previously recorded. Previously differences observed in other series of experiments have been as follows: 1.10 bags; 0.99 bags; 0.91 bags; and 1.36 bags per acre. The average difference between these treatments is therefore, 1.26 bags per acre of maize. It is thought that this unusual superiority shown by the whole crop was due to the fact that the greater quantity of humus supplied to the soil assisted the maize better to withstand the severe drought during the early part of the growing season.

It will be seen that the mature stubble has given a lower yield of maize by 2.18 bags per acre than the immature stubble. This is the reverse of previous experimental results, and it is considered that this is due to the fact that a mature stubble of sunn hemp ploughed under in dry soil has always been found to give a very strong forcing effect on the following maize crop, and in this case the over stimulated maize was less able to withstand the severe drought. It was noted that all the plots under this treatment were very severely affected by the drought.

The possible reasons for this forcing effect in a mature stubble are still under investigation, but it may perhaps be mentioned that it is thought that it is due to the fact that litle or no nitrogen is lost during the winter from a mature stubble ploughed under in dry soil, and that nitrate production quickly reached its peak just after germination of the maize crop, and yields an excessive nitrogen supply to the young maize.

Conclusions.—*Increasing the seeding rate of Somerset sunn hemp has given a profitable increase in the yield of maize up to a seeding rate of 60lbs. per acre.* Increase of seeding rate beyond 60lbs. per acre yielded no advantage.

In view of the increased yield of maize, which may be obtained, and the greater efficiency of the crop in smothering weeds, farmers are recommended to increase the seeding rate of Somerset sunn hemp to 40lbs. per acre.

If the crop is cut for hay or silage for composting further advantages obtained by this increase in seeding rates will be finer quality of hay, and an increase in the yield of hay, silage or compost. This was shown by the weights of hay removed from the plots under sub-treatment (b) and (c), previously recorded in the JOURNAL (3).

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The Production and Handling of Milk and Cream.

By The Dairy Branch.

"*Quality is never an accident; it is the result of good workmanship, conscientious effort and intelligent management.*"—(National Butter and Cheese Journal, 10th January, 1937).

The average Rhodesian farmer does not exercise sufficient care in the production and handling of milk and cream with the result that a considerable proportion of the butter and cheese and other dairy produce manufactured or produced in the Colony is of inferior quality; in fact, reference to the most recent figures available on the subject discloses the fact that approximately 50 per cent. of the butter and cheese made in the territory is of Second and Third grade quality.

This is a very unsatisfactory state of affairs. In the first place it should be borne in mind that the production of such excessive quantities of low grade products for which there is a limited local demand not only restricts consumption and brings the industry into disrepute, but also entails a heavy financial loss amounting annually to thousands of pounds which has to be borne by the producer and the industry generally. Secondly it must be remembered that the present output of dairy produce is in excess of the Colony's consumptive requirements and that considerable quantities of butter—and to a lesser extent cheese—are being exported annually to countries overseas and elsewhere; in fact at the moment the dairying industry is passing through the initial stages of building up an export trade in dairy products and it is unfortunate, therefore, for obvious reasons that the surplus available for export should consist, to the extent indicated, of produce of inferior quality. There is little doubt that the future development of the dairying industry depends almost

entirely on the prospects of establishing an export trade and this being the case it is essential that every effort be made by the producers to supply the creameries and cheese factories with milk and cream of the best quality in order that the products manufactured therefrom may be of a standard high enough to ensure a ready sale on the highly competitive markets overseas.

Finally, the dairy farmer should bear in mind that he owes a certain duty to the consumer of dairy products who since he is paying as high a price in Rhodesia as that paid anywhere else in the world for dairy produce, has every right to expect that the article for which he is paying is clean, safe and of high nutritive value. His responsibilities in this direction are frequently overlooked by the dairy farmer who is inclined at times to rely to far too great an extent on his untrained native employees who, on account of their low standard of living and lack of knowledge and appreciation of the elementary principles of hygiene, are unable to grasp the significance of the various precautions which have to be taken in the production and handling of dairy produce. Under constant supervision the more intelligent native can be used with a considerable degree of success but it must be emphasised that dairying is an occupation which requires intelligent workers who understand and appreciate cleanliness and the control of bacterial contamination; for this reason the dairy farmer should always make a point of seeing that the various operations connected with the production and handling of milk and cream are carried out under his personal supervision.

The production of clean, healthy milk is based on bacteriological principles; in fact apart from the various flavours and odours which can be absorbed by milk from its surroundings or which can be imparted to milk or cream by certain feeds, weeds and plants, etc.—to which reference is made later—the defects most commonly found in dairy products are caused by bacteria. These organisms which gain entrance to the milk from a variety of sources find therein almost ideal conditions for their growth and development. For all practical purposes it can be assumed that all milk contains some bacteria but the effect or change produced by these organisms in milk or cream depends very largely

on the types which happen to be present and the temperature at which the milk or cream is kept. Many of the bacteria found in milk appear to be inactive but some of the types most commonly found are able to cause marked changes in the appearance and flavour of both milk and cream; this latter class includes the bacteria which cause milk to go sour and which cause gassy or putrefactive fermentations, and produce undesirable flavours and odours.

It is important to bear in mind the fact that the rate at which bacteria grow and increase in number depends very largely upon the temperature at which the milk or cream is kept. The bacteria most commonly found in dairy products multiply most rapidly at temperatures between 80°F. and 100°F.; the rate of growth and multiplication may be exceedingly rapid—in fact under favourable conditions a single organism is capable of attaining full growth and then dividing to form two new bacteria in a matter of 20 to 30 minutes. At a temperature of 50°F. and below, however, the rate of bacterial growth and multiplication is considerably retarded. This fact has an important practical bearing and illustrates the necessity for the prompt cooling of milk and cream at all times.

As previously stated, milk invariably contains some bacteria which gain entrance thereto from a number of sources of which the following are the most important.

1. **The Cow Stable or Milking Shed.**—Generally speaking the cow stable or milking shed if kept reasonably clean is not a serious source of bacterial contamination. The stable air usually contains bacteria but the actual number of organisms which gains entrance to the milk from this source is not as large as might be expected although the extent of the contamination varies according to the condition of the stable; hay, dirty bedding and any other dry, dust producing materials will increase the number of organisms present, whilst the manner in which the cows are fed will also influence the amount of contamination which takes place; generally speaking bacteria are most plentiful in the stable immediately after feeding, especially when cows are fed on dry dusty foods, such as hay, etc., and if milking takes place immediately after feeding, a considerable number of organisms may

be found in the milk. For this reason dry dusty feeds should be given to the cows after the milk has been removed from the stable; this procedure should also be followed with feeding stuffs which are likely to impart foreign flavours to milk, such as silage, etc. The contamination which takes place when cattle are milked in an open, dusty, wind-swept, manure laden kraal will be very much greater than that which occurs in a clean well kept stable or milking shed. Fig. 1 illustrates a properly constructed, well kept cow shed in which, with proper feeding practices, bacterial contamination should be negligible.

2. The Body and Udder of the Cow.—Another source of of bacterial contamination is the cow herself; her skin, even when kept in fairly good condition is never very clean and will always hold a certain amount of dirt and dust laden with bacteria.

Cows which are allowed to run day and night usually keep cleaner than those which are stabled but the former although they may appear to be clean may, nevertheless, be carrying large numbers of bacteria on their coats; it is well known that bacteria are found in considerable numbers on practically every type of vegetation, a fact which assumes considerable practical importance when it is borne in mind that it is difficult at certain times of the year to prevent cattle from wandering in the long grass and bush, as a result of which their udders, flanks, etc.—in fact their entire bodies—may become seeded with organisms which, unless the greatest care is exercised at milking, may ultimately find their way into the milk.

In a poorly kept dairy herd where the cow is rarely cleaned, her flanks, tail and skin may become covered with a coating of manure and filth, carrying bacteria in large numbers. During the process of milking, the manipulation of the udder and the movements of the cow, cause a constant shower of dirt to fall from the body of the animal into the milk pail; the dirt that finds its way into the milk in this manner, consists of manure, grass, hairs, bedding, mud and dust, etc., all carrying organisms often in considerable numbers; most of the dirt ordinarily present in milk is derived from this source

and gains entrance during milking operations. The actual amount of dirt found in milk may vary considerably and so, too, may the numbers of bacteria present in it.

Dirt from the coat of a clean cow has been found by some investigators to contain over 17,000,000 organisms per gram while that from the coats of four dirty cows varied from over 184,000,000 to 4,592,000,000 per gram* The types of organisms derived from this source are in general the types associated with manure, soil, feeds and bedding; many of them are decidedly objectionable on account of the rapid and undesirable fermentations which they bring about in milk and cream. It is apparent therefore that the dirt which falls into milk during the milking process may be a serious contaminating factor.

A further source of contamination is the cow's udder. It is now generally accepted that even an apparently healthy udder may, and invariably does, harbour bacteria sometimes in considerable numbers.

From a practical view point, therefore, milk even if produced under ideal conditions, is liable to be contaminated with bacteria from the interior of the udder. If the udder is diseased or injured or affected with "mastitis" then bacteria may be excreted in the milk in very large numbers. It should be noted that the fore milk generally contains the highest number and the strippings the least number of bacteria.

3. The Milker.—The milker may also be a source of contamination inasmuch as he may add organisms to the milk from his hands and clothing and also by coughing and sneezing during milking. If wet milking is practised, as is frequently the case with the native milker, then considerable numbers of organisms may be washed into the milk from the milker's hands and from the exterior of the udder and teats. Contamination from the milker or other persons in the dairy may be very serious as the organisms coming from the throat, mouth, etc., may include certain harmful types and cause disease.

*Illonois Agri. Expt. Station, Bulletin 236, 1921.

4. The Utensils.—Generally speaking, utensils which have not been properly cleaned and sterilised are the main source of bacterial contamination on the average dairy farm. Numerous investigators have shown that the number of organisms which gain entrance to the milk from the air and from dust, etc., is almost negligible compared with the numbers contributed by unsterilised utensils such as pails, cans, strainers, separators and coolers.

Unless all equipment of this description is actually sterilised either by steam or by immersion in boiling water it is likely to be a serious source of contamination and may add enormous numbers of bacteria to any milk or cream which comes into contact with it. Cleaning and washing alone is not sufficient. The complete removal of particles of milk or cream, grease or other material from the surface of any dairy utensil is well nigh impossible and organisms will grow and multiply with great rapidity in utensils which have been well washed with hot water and which are apparently clean. To a great extent the ease with which a utensil can be cleaned and sterilised depends on its condition and the material of which it is made. Wooden utensils for instance are more liable to absorb and retain milk particles than metal equipment but even the latter may be very difficult to clean if it has developed any cracks or crevices in which bacterial growth may take place. All dairy utensils should be so constructed that they can be thoroughly cleaned and dried; pails, cans, etc., should be seamless—a folded seam such as is found at the bottom of a petrol tin or dip drum is a decided objection as it provides a refuge for bacteria from which they cannot be dislodged by any ordinary method of cleaning—even steam treatment will not destroy them completely; receptacles of this description should never be used as containers for milk or cream.

The separator is a very common source of bacterial contamination; at the best of times a separator is difficult to clean, but when, as frequently happens, the machine is not cleaned immediately after use or if it is not taken apart to be cleaned, being merely rinsed by passing water through it then it becomes a very serious source of contamination; there is little doubt that the growth of organisms in unwashed or unsterilised separators is one of the most common causes of

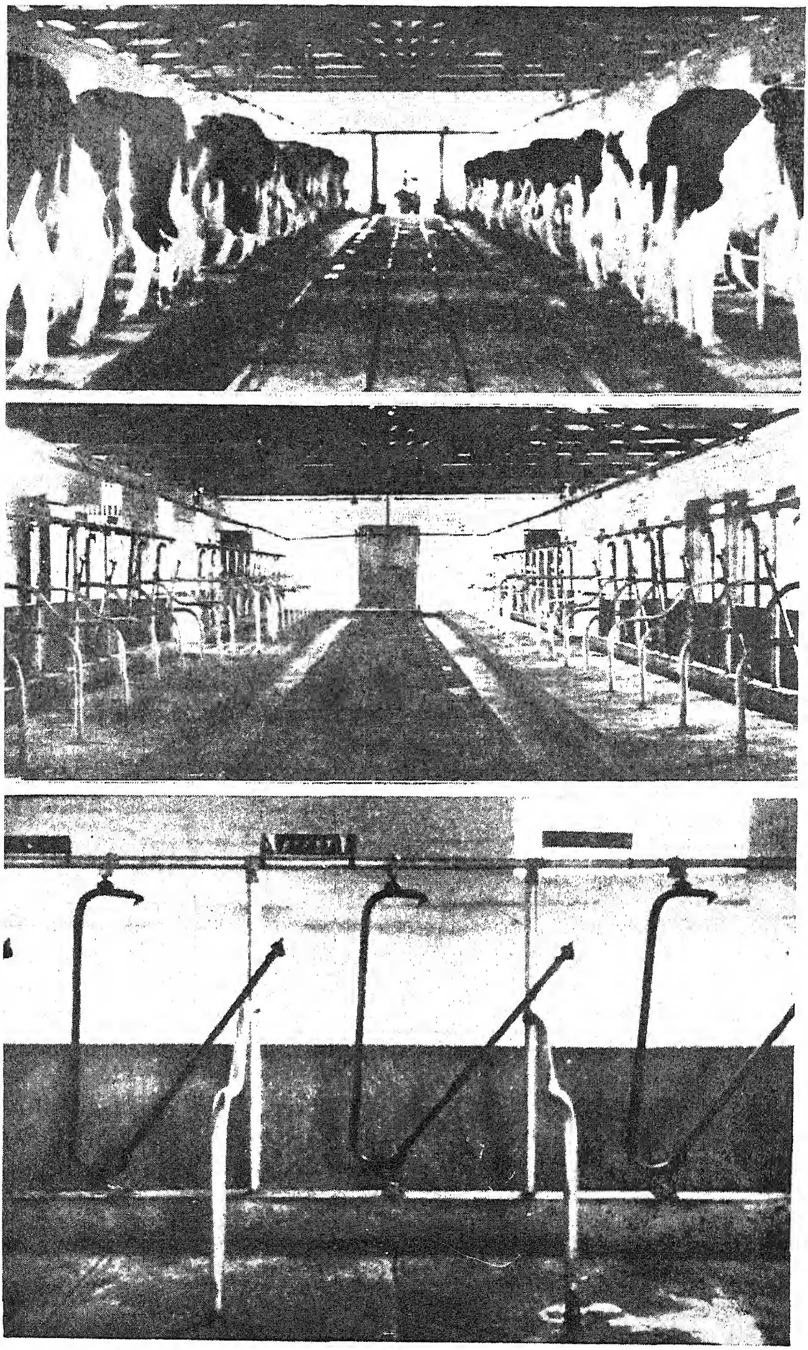


Fig. 1.—A well designed, properly constructed cowshed equipped with modern fittings.
(P. B. Morrisby—Sunnyside Farm, Gwelo).

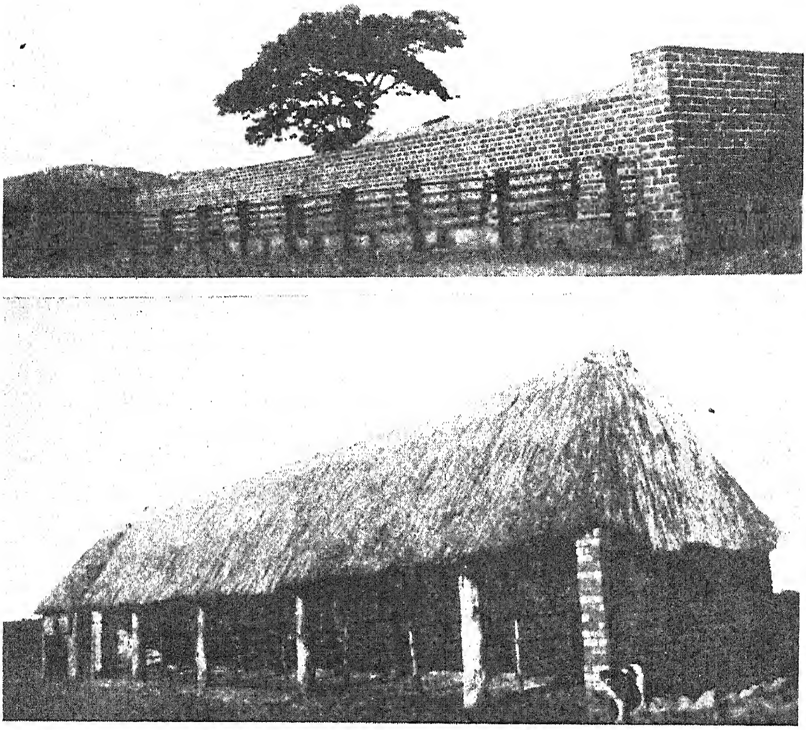


Fig. 2.—Two types of a simple lean-to milking shed. (Note—Roof not yet placed on shed in top illustration).

Fig. 3.—Preparing the cow for milking—wiping the udder and teats with a damp cloth.

the undesirable flavours and odours and objectionable fermentations which are characteristic of so much of the cream supplied to the creameries during the warm season of the year.

The types of organisms added to milk as a result of utensil contamination are rather varied but generally speaking the organisms found in greatest amount are acid-producing bacteria of the type responsible for the souring of milk and cream although other types capable of causing undesirable fermentations are frequently present; utensils which have been washed in polluted or contaminated water and which are not properly sterilised may also harbour organisms capable of causing disease.

5. Other Sources of Contamination.—Amongst other sources of contamination mention should be made of the water supplies. The necessity for a supply of clean, pure water for cleaning utensils and for drinking purposes for the cattle cannot be over-emphasised. Stagnant pools, in which cattle are frequently allowed to wade and drink, are a fruitful source of the organisms producing gassiness and other undesirable fermentations in milk and cream.

Flies are also a serious source of bacterial contamination; they appear to carry a phenomenal number of organisms, as many as 6,000,000 having been found on the body of a single fly. Obviously flies may seriously contaminate any utensil on which they happen to settle and when a fly falls into warm milk these bacteria have a perfect medium wherein to increase; it is only too common a sight in Rhodesia to see a milk can without a cloth or covering with an inch or two of the of the surface of the milk simply swarming with dead flies or to see flies falling in large numbers into the cheese vat during the cheese making process. It is a curious fact that many dairymen, who are scrupulously clean in their own homes and who would not dream of drinking a cup of tea in which a few flies had fallen can yet contemplate spectacles of the nature described with the greatest of equanimity. Flies so commonly alight on fecal matter that the bacteria they carry on their bodies may be regarded as definitely objectionable from a dairymen's point of view not to mention the possibility of infection of the milk with organisms dangerous to health.

It is clear from what has been stated that, apart from the organisms derived from the interior of the udder and over which the dairymen has little, if any, control, the main sources of bacterial contamination of milk on the average dairy farm are unsterilised utensils, unclean udders, the milkers' hands and flies, etc.

The production of clean milk resolves itself therefore into a matter of reducing or eliminating, as far as possible, the contamination from these sources and this can be achieved, without the aid of expensive equipment or buildings, by the observance of certain simple precautions and constant attention to detail.

1. **Milking Sheds.**—Whilst elaborate cow stables or byres are not essential for clean milk production, it is nevertheless necessary that milking operations should be carried out in clean surroundings. Milking out in the open air on the grass is possibly the ideal method but unfortunately it is not practicable to follow this system at all times of the year owing to wind, rain, dust, flies and accumulations of mud and manure. A suitable milking place must be provided and this may take the form of a simple shed or if necessary a more elaborate cow-stable according to circumstances.

Under the climatic conditions which obtain in this Colony, it is practicable for dairy cattle to remain out day and night throughout the year and where this system is followed a simple lean-to shed of the type illustrated in Fig. 2, where the cows can be milked and fed is quite satisfactory. A shed of this description can be erected very cheaply.

If the milking cows are stabled at night, as is sometimes necessary in the case of town dairies, then a rather more elaborate cow byre of the type illustrated in Fig. 1, should be provided.

Whatever type of shed is erected it should be so situated that it can be readily drained so as to prevent any accumulation of mud, solid and liquid manure, dust and dirt, etc., and it should provide shelter from the prevailing winds; the shed should be situated also so as to comply with the requirements of the recently introduced dairy regulations which provide that, unless otherwise approved, the cow stable,

milking shed or kraal shall be a distance of not less than 100 yards from any residential quarters and a similar distance from any piggeries or manure pits as well as a distance or not less than 100 feet from any other kraal or from the dairy. In the case of a shed of the type illustrated in Fig. 2, which is used for milking and feeding purposes only, considerations as to the floor and air space allowed for each cow are of little significance provided that the cows are not unduly crowded. In the case of cow byres in which the cattle are stabled at night ample ventilation should be provided and it is usually considered that 600 cubic feet of air space and 60 square feet of floor space should be allowed for each cow. The floor should be constructed of cement, concrete or other suitable impervious material and this should have a slight slope from the feeding trough to the manure channel at the back of the cow.

The milking shed or stable should be thoroughly cleaned out after each milking by the liberal application of water to the floor, manure channel and feeding trough until all feed remnants, manure, dust and dirt have been removed. The manure and soiled litter should be removed and either spread out to dry or be carted to a properly constructed manure pit. Too often the manure is dumped in close proximity to the cow shed and forms a perfect breeding place for flies.

The cow shed should be whitewashed at least twice a year. The addition of salt and a small quantity of alum to the ordinary lime wash gives good results and the mixture forms a hard durable wash which will not easily rub off; the preparation is made as follows.

20lb. unslaked lime.
3lb. common salt.
$\frac{1}{4}$lb. alum .

Slake the lime with boiling water until the consistency of rich milk. Then add the salt and alum and stir thoroughly until dissolved and mixed. Skim milk white-wash prepared as follows has also given satisfactory results. Fill a big drum about $\frac{1}{3}$ full with unslaked lime and add water in small quantities to slake it; cover up and leave until next day; then take some of this lime and add an equal quantity of

cement, mix thoroughly, thin down with skim milk and run through a sieve to take out coarse stuff, if any; water, in which some salt has been dissolved, can be added before the wash is applied; the mixture must be stirred well when it is being thinned down to the required consistency. The function of the skim-milk is to help the wash to "stick" to the wall and the salt helps to harden it; cement by itself is liable to peel off; when slaking the lime do not add all the water at once owing to the heat generated.

2. **Clean and Healthy Cows.**—The milking herd should be periodically inspected and no animal suffering from any udder disease should be allowed to contribute to the milk supply; careful watch should be kept of the udders of the cows and whenever any signs of udder disease appear in the form of inflammation or hardness, running sores or the appearance of bloody milk, the animal should be excluded at once from the milk producing herd until complete recovery has taken place. The regular use of a so-called "strip cup" as a rough method of detecting "mastitis" should be a routine practice on every dairy farm. These are precautions which are far too frequently neglected.

A great reduction in contamination can be accomplished by keeping the cows clean; if the flanks, udder, etc., of the cow are caked with dirt, as is usually the case where stabling is practised, it is best to remove the dirt and hair together by means of hand clippers and in order to facilitate subsequent cleaning the hair on the udder and flanks can be clipped; it is not necessary to clip too large an area—as a rule it is sufficient to keep the hair short only in the neighbourhood of the udder. If this hair is occasionally cut, the contamination of milk from the cow's body is lessened. Grooming, i.e., brushing the cow's coat, is at times necessary, but if possible this should not be done just before milking as this operation may create a considerable amount of dust.

If the cows are out day and night their coats are not so likely to become soiled. In any case the cow should be prepared for milking by wiping the flanks, udder and tail with a clean damp cloth which has been dipped in a weak solution of some disinfectant. Washing, i.e., plentiful appli-

cation of water to the udder, is not advisable, except in extreme cases, as this practice has been known to cause chapped teats, especially, as is usually the case, when the drying of the udder is perfunctorily performed. The preparation of the cow for milking should constitute a regular practice; if the cows are fairly clean, cleansing of the flanks, udder and teats will only take a few minutes. Fig. 3 shows a native attendant preparing a cow for milking.

There are various commercial preparations on the market which can be used as disinfectants; in most of these the active principle is chlorine; some of them are put up in powdered form and are thus very convenient to use, as a small quantity of the powder can be added directly to the water which is used for cleaning the cows' udder and teats. A cheap disinfectant solution can, however, be prepared by any farmer according to the following directions.

Dissolve 1lb. of Chloride of Lime in two gallons of water. In making the solution first prepare a smooth watery paste of the lime and then add the water, a little at a time, until the solution amounts to two gallons. Then stir and strain into a glass bottle or jar, and keep well corked in a cool dark place. This is the stock solution. To dilute this stock solution to the proper strength for use add water to it at the rate of four gallons to each ½ pint of the stock solution. This dilute solution should only be used once, i.e., a fresh solution has to be made up every day. Two gallons of the stock solution should last the average dairyman a full month.

(To be continued)

Seventeenth Annual Report of the Division of Forestry,

FOR THE YEAR, 1936.

By E. J. Kelly Edwards, M.A. Dip. For. (Oxon),
Conservator of Forests.

INTRODUCTION.

Kalahari Sand Forests.—It is gratifying to report that the outstanding feature of the year's work has been the great progress made in assessing the Umgusu (*Baikiaea plurijuga*) timber resources in North Western Matabeleland.

Two field parties surveyed 1,000 square miles of the Gwaai Native Reserve and 220 square miles of Crown Land in the Bubi District and it was found that about one-fifth of the surveyed area carried exploitable Umgusu (Rhodesian "Teak") Forest.

The surveys have served to confirm previous suspicions that if the rate of exploitation carried out of late years continues, a serious lack of timber will result in a few years' time. This would mean the virtual closing down of a promising industry, which has not only yielded over £60,000 to State revenues in less than twenty years but has provided a steady employment to many Europeans and thousands of natives.

A preliminary survey of the position shows that of 1,430 square miles of Umgusu forest, 950 square miles have been exploited during nineteen years and the average annual exploitation has been 70 square miles during the past nine years.

Of the balance of 480 square miles, 180 square miles are committed for exploitation, leaving a reserve of 300 square miles of which one-sixth is at present classed as inaccessible forest.

At the present rate of exploitation it will be seen that only seven years' supply remains.

It is therefore imperative that existing supplies should be fostered by proper forest management and that the regrowth and middle aged classes in exploited forest be protected with a view to bridging the gap in supplies which is imminent. It is hoped that the more detailed investigation of this important matter now in progress will reveal a happier position than preliminary results indicate.

During the year, apart from assessment surveys, large scale fire protection operations were continued and it is pleasing to record that of 403,000 acres protected only 3.4 per cent. were traversed by fire, fortunately with little ill result.

Other Forest Stations.—At Mtao, which is subject to erratic rainfall during the planting season, the extra soil preparation which has become standard practice of late years has proved very successful in establishing young stands. It is, nevertheless, by no means certain that the establishing of even sized crops is an unmixed blessing, for several older stands which in youth looked unsightly as a result of minimum soil preparation have now closed to more natural forest and offer less difficulty in thinning and disposal of thinnings. This important matter is and will be the subject of careful observation, but in the meanwhile the apparently safer methods at present followed will be continued.

The Chaka Nurseries maintained at Mtao to provide light employment for elderly men had a smooth and satisfactory year. On an average over fifty-five men were in the camp during the year. Their health was excellent and they were a contented and self-respecting lot who gave no trouble to the Welfare Officer.

At Stapleford preparation for the increased planting programme decided on in May was well in hand at the end of the year, and it is hoped that some 600 acres will be planted during the present season.

The European Unemployment Relief camp was maintained and functioned smoothly. The average number of men in employment was twelve. They were engaged partly in forestry work and partly in completing a major road deviation outside the reserve.

National Parks and Game Reserves.—The programme of sinking boreholes and erecting windmills in the Wankie Game Reserve to maintain a satisfactory level of water in adjacent "pans" commenced in 1935 was completed, and there are six windmills in various parts of the reserve. The efficiency of this scheme will not be proved until another bad dry season is experienced.

Game have shown a tendency to increase in the Victoria Falls Game Reserve, while in the Gwaai Forest Reserve, where strict protection has been carried out for six years, the increases have been remarkable, so much so that buffalo have taken up old haunts from which they have been absent for probably a quarter of a century.

The Victoria Falls Reserve continued under the control of the Division pending fresh administration required by the "Monuments and Relics Act, 1936." The indications are that there will be no change.

The Division completed its first year of the control of the Rhodes Inyanga Estate. The popularity of the Estate as a holiday resort is now such that further hotel accommodation is essential.

STATE FORESTS.

A portion, 558 acres in extent, of the farm "Korsten" adjoining the northern boundary of the Stapleford Forest Reserve was acquired as an addition to the Reserve free of cost as the farm had reverted to Crown Land.

During the year the Ngamo Forest Reserve was removed from the "open shooting" area and as valuable Umgusu regeneration now exists, steps will be taken to initiate fire protection operations during 1937.

A start was made by a land surveyor in defining the north western and south eastern boundaries of the Gwaai Forest Reserve, and a portion of the northern boundary of the Wankie Game Reserve was demarcated by the Game Warden.

The boundaries of farm "Simla" and a portion of farm "Walmer" where they adjoin the Stapleford Forest Reserve were fenced for a distance of 3.9 miles at half cost to the Government.

Management.—Topographical surveys at Stapleford were curtailed owing to changes of staff.

In the Umgusu (*Baikiaea plurijuga*) forests great progress was made in reconnaissance surveys, in the Gwaai Forest Reserve, in the Fuller Forests, in the Gwaai Native Reserve and in unoccupied Crown Land in the Bubi District. Arrangements are being made to incorporate the latter area into Forest Reserve.

The preliminary figures obtained from these surveys do nothing to lessen the anxiety that has long been felt as to the total supplies of merchantable timber available, and in fact, only emphasise the obvious necessity of controlling the annual cut in the very near future.

It is only by this means, combined with the protection of immature forest and measures to ensure that all available timber is utilised to the best advantage, that the important sawmilling industry can be maintained on a permanent basis.

In the meanwhile many interesting results have been obtained from this work. Preliminary volume tables have now been prepared for the nine main forest species of the area and provisional regional quality classes have been ascertained.

Protection.—All forest reserves were regularly patrolled.

At Mtao 147 miles of fireguards were maintained. One fire occurred in a vlei and burnt 60 acres of grass.

In the Kalahari Sand Forests fire protection operations were carried out over an area of 402,750 acres.

Approximately 314 miles of fire-lines were maintained. No fires occurred in the Fuller-Masue area but there were two fires on the Gwaai Forest Reserve, both of these having been started maliciously.

The major fire covering 12,560 acres burnt through an area of good "Umgusu" forest but owing to the fact that it burnt against the wind and that regeneration was absent, little damage was done.

The second fire started in a vlei and covered 1,240 acres, before being extinguished. No damage was done to timber.

As a result of these fires 3.42 per cent. of the protected areas in the Kalahari Sands were traversed by fire. In view of the very rank growth of grass experienced this must be considered highly satisfactory.

More serious were the widespread fires in unprotected Umgusu forests. The whole of the Gwampa area has again been burnt and also a large portion of the country to the East of the Gwaai Forest Reserve.

Fires swept up to the boundaries of the Masue Forests on three sides and lesser areas were burnt to the north and east of the Fuller Forest.

Finally a great portion of the main Umgusu belt in the Gwaai Native Reserve has been swept by fire.

The Forest Officer to the Native Reserves Trust again laid out firelines in a small portion of the Gwaai Native Reserve, north of the Bulawayo-Falls Railway line.

It has become obvious that a reduction in the numbers of native-owner cattle must be brought about in the Gwaai Forest Reserve as owing to constant grazing in defined areas they are causing considerable damage to young regrowth.

Spring-hares continue to cause damage to young trees at Mtao but systematic shooting of these pests has reduced the numbers considerably.

Occassional rat damage is still experienced at Stapleford but this can now be controlled by weeding out the grass *Eragrostis grandis*.

It has become only too plain that an agreement similar to that in force at Stapleford must be drawn up with natives resident in the Gwaai Forest Reserve. At present little control is possible and natives do not even turn out to assist in quelling fires when called upon to do so. The two fires which have occurred on this Reserve are known to have been set maliciously but it has not been possible to arrest the culprits.

Six natives were prosecuted for trespass on the Mtao Forest Reserve.

Cutworms caused some damage among seedlings in nurseries at Stapleford and Mtao but these were controlled by handpicking.

Frost damaged *Pinus insularis* and *Eucalyptus mircocorys* in low-lying ground at Stapleford and several specimens of *Eucalyptus naudiniana* were killed in the arboretum.

SILVICULTURE.

Natural Reproduction.—At Stapleford natural reproduction of *Euclaypts*, *Pinus patula* and *Cupressus lusitanica* has been noted.

In the Kalahari Sand Forests the natural regeneration of Umgusu has been most prolific.

Mopani (*Copaifera mopane*) seeded more prolifically than hitherto recorded and in favourable areas regeneration of this species is remarkable.

M'chibi (*Copaifera coleosperma*) also seeded well and at the close of the year *Afzelia quanzensis*, *Baikiaea plurijuga* all showed promise of producing heavy crops of seed.

On account of the excellent seed year and resulting regeneration it is of the greatest importance that fire protection operations be instituted in the Ngamo Forest Reserve in 1937.

Artificial Reproduction.—Afforestation carried out during the year was as follows: —

Station.	Revised total Area Afforested at 31-12-35.	Afforested during 1936.	Total Area afforested at 31-12-36.
	Acres.	Acres.	Acres.
Salisbury Forest Nursery ...	43.50	—	43.50
Mtao Forest Reserve	1,819.36	242.95	2,062.31
Stapleford Forest Reserve	3,424.39	439.45	3,863.84
Totals	5,287.25	682.40	5,969.65

In addition, 67.73 acres of poorly stocked compartments were replanted at Mtao.

NURSERIES AND SALE OF SEEDS AND TRANSPLANTS.

Four nurseries were maintained at Stapleford and one at Mtao. The nursery at Mtao, known as the Chaka Forest Nurseries, provides employment for elderly Europeans who are unable to obtain employment in the open market. The major cost of the nursery is borne by Relief Votes while the Forest Service bears the cost of technical supervision and of transplants at rates which would be paid if native labour were employed.

The Salisbury Nursery continued to supply plants and seeds to the public and advice was given in the neighbourhood when required.

Sales from this Nursery showed a satisfactory increase of over £200 as compared with last year, the cash revenue increasing by approximately £180.

The issue of plants to Government Institutions such as the Schools and Police camps, forms a considerable proportion of the work at this station, and during the year, the value of such plants was £727 3s. 4d., while the total Revenue was £2,258 11s.

There were 1,200 visitors during the course of the year.

Operations for the Improvement of the Growing Stock.—Experimental thinnings and prunings have been carried out in young *Pinus radiata* stands at Stapleford and Mtao. Some remarkably cheap results have been obtained with a special pruning saw made to the specification of the British Forestry Commission.

Experimental thinnings and prunings of Umgusu have also been undertaken in the Gwaai Forest Reserve.

Trial of New Species. — Perhaps the most important species introduced during the year is *Mimosa bracatinga,* which is indigenous to Brazil.

Preliminary trials at all stations indicate that this tree germinates readily if sown "in situ" and makes rapid growth. Although said to be of value for firewood only, the importance of such a tree, if proved to be successful, to farmers and natives cannot be over-estimated. Further trials will be undertaken during the coming year. An average height of four feet in eleven months from seed has been attained at both Mtao and Stapleford. *Pinus insularis* is showing some promise at Stapleford but has been killed when planted in a frost hollow.

Trial sowing of *Balanites maughamii* and *Balanites aegyptiaca* the fruits of which when soaked in water kill the snails carrying "*bilharzia*" are being carried out at the Salisbury Nursery.

Silvicultural Notes.—*Eucalyptus sieberiana* has died back badly and it would appear that this tree which has been planted on an experimental scale only is not suited to the district of Mtao.

Pinus pinaster continues to die off completely and it can now be definitely stated that this tree is unsuitable at Mtao.

The preparation of land now carried out at the Station, viz., the thorough ploughing and harrowing continues to give eminently satisfactory results and it is seldom necessary to resort to blanking.

Further valuable information has been acquired in the Kalahari Sand Forest more especially with regard to the

rate of growth of Umgusu, which in ten years from seed averages eleven feet in height and four inches in girth at breast height.

The period between leaf cast and flushing of the Kalahari Sand trees was the briefest yet observed.

The effects of invasion by *Brachystegia randii* in the Umgusu belts was again noted, and steps are being taken to evolve methods of control.

Seeding and regeneration of almost all indigenous tree species has been remarkable.

Herbarium.—Forty-three specimens were despatched to the Imperial Forestry Institute during the year of which, twenty-four have so far been determined. Seven further determinations were received for specimens previously despatched.

A contribution of £100 was made to the Institute for the year. Various publications have been received notably a regular monthly index to current Forest Literature.

EXPLOITATION.

At the Mtao Forest Reserve there was a considerable falling off in the sale of Eucalypt timbers due largely to sales at low prices by private growers. Nine hundred cubic feet of Eucalypt poles were sold.

At Stapleford a small amount of thinning has been carried out in the isolated plantations set out by the previous owner. These thinnings consisting of *Pinus radiata* and *Pinus patula* have been sawn up and will be utilised on the Reserve or for show purposes.

In the Kalahari Sand Areas the exploitation of the Umgusu (*Baikiaca plurijuga*) forests was continued by the Rhodesian Native Timber Concessions. The output during 1935 was approximately 458,000 cubic feet of sawn timber from Crown Lands and Native Reserve.

It is more than likely that the cut has not yet reached a climax, and this, coupled with the results now rapidly being accumulated from surveys of the available timber

resources emphasises the necessity of regulating the cut as soon as possible if the industry is to be maintained on a permanent basis.

It is indeed pleasing to be able to record that the saw-millers are making greatly increased efforts to obtain a satisfactory recovery from their mills, not only because this helps to conserve existing stocks of standing timber, but also because it indicates this Division's oft repeated contention that the introduction of sales of the timber in the round would have this result.

The millers are helped towards this object by the increasing sales of parquet flooring strips. The introduction of the use of a thin Swedish saw for felling, increased the sound log volume which leaves the forest by some 10 per cent. or more.

With regard to the Savannah Forests in the Colony, the position, in spite of certain opposing factors, is no doubt becoming annually more serious.

Notwithstanding the introduction of crude oil engines, and in some districts, electricity as a source of power in the mining industry, the number of small mines has increased so rapidly that it is considered that the quantities of timber used have in no way been reduced. Furthermore, with the expansion of base metal mining and the large amount of development work being done, a vast quantity of timber is now being used underground.

That a shortage is becoming realised is indicated by the changes in fuel already referred to, coupled with an increasing demand on the exotic plantations of the surrounding districts.

This shortage of fuel is being equally felt by the farming community and natives.

In the districts growing tobacco it is in many cases acute and has even resulted in the abandonment of certain farms, while in other cases increasing attention is being paid to tree planting. The agricultural community continues to show an interest in tree planting although the area planted can hardly be considered adequate.

Investigations in certain native reserves show that the timber shortage is acute. Apart from conservation and the avoidance of waste the main remedy is to plant fast-growing exotics, for what is undoubtedly required is the production of the largest volume in the shortest possible time.

COMMUNICATIONS AND BUILDINGS.

All Forests Reserve roads were kept in repair.

At Stapleford approximately $1\frac{1}{2}$ miles of road was constructed by Europeans, thus completing the new road out of the Reserve. A further 140 yards of main road and $10\frac{3}{4}$ miles of paths were constructed on the Reserve.

Towards the close of the year a commencement was made with the construction of motor roads in the Gwaai Forest Reserve, and the road from the Forester's quarters to the Victoria Falls was re-aligned.

A Recreation Room was built by the Public Works Department for the use of the men at Chaka Nurseries.

At Stapleford new quarters for the foreman were completed by the Public Works Department and various additions and improvements were carried out to other quarters.

Quarters for the District Forest Officer constructed entirely of wood were completed, and a borehole was sunk in the Gwaai Forest Reserve.

The stables at the Salisbury Forest Nursery were dismantled and a new storeroom constructed with the material.

Livestock.—The livestock on hand at the end of the year consisted of 10 horses, 192 oxen, 61 donkeys and 2 mules.

FINANCIAL RESULTS.

The revenue, unaudited, for the year, including free issues and timber royalty paid to the Department of Lands amounted to £6,180 19s. 8d., an increase of £603 17s. 8d., as compared with the total of £5,577 2s. in 1935. Expenditure, unaudited, exclusive of salaries and allowances of the permanent staff was £7,619 15s. 6d.

ADMINISTRATION.

The permanent staff at the end of the year consisted of one Chief Forest Officer, five District Forest Officers, six Foresters, one Nursery Manager, one Assistant Nurseryman, two Foremen Foresters, two Learner Foresters, one Game Warden, one Assistant Game Warden, one Curator, Victoria Falls; one Manager, Rhodes Inyanga Estate; and one Clerk. Total 23.

During the course of the year, the Native Reserves Trust Forest Officer was taken on the strength of the Division as a District Forest Officer, but remains seconded to the Native Department.

One Forester resigned during the year and one was retired on account of ill health. One Foreman was promoted during the year to the rank of Forester.

Private Forests.—According to the statistics available the area under private forests totalled 20,732 acres as compared with 18,472 acres last year.

During the year, 25 private forests were visited officially by Forest Officers and three addresses were given to Associations.

The Salisbury and Umtali Agricultural Shows were attended.

Plantations at Gwebi Farm were inspected and an estimate of timber available from thinnings was drawn up.

NATIONAL PARKS AND GAME RESERVES.

Victoria Falls Reserve.—This Reserve was patrolled as usual and paths and vistas were maintained. A new path along the edge of the first gorge was constructed and with the aid of labour provided by the Roads Department a circular motor road was constructed along the River bank to Kalai Island and thence back via Dale's Kopje.

The year was an exceedingly good one for tourist traffic and it is worthy of note that owing to the improvement of the road leading to the Falls a large proportion of tourists now arrive by car.

The huts and cheap transport provided by the Northern Rhodesia authorities are proving an increasing attraction to such visitors who thus tend to make their headquarters on the opposite bank.

At present no suitable facilities exist for the temporary housing of the large numbers of natives who use this point as a port of entry. It is to be hoped that funds will be provided during the coming year for a suitable compound to be erected.

The Curator was seconded to act as an official at the Empire Exhibition held in Johannesburg during the year and his duties were performed by the Forester of the Fuller-Masue forests.

Wankie Game Reserve.—During the year an Assistant to the Game Warden was appointed. This appointment has resulted in greatly reduced poaching owing to the supervision of native rangers.

No new roads were constructed during the year but the existing system was improved and kept in repair.

The closing of a large proportion of the free shooting area adjoining the Reserve should do much to improve the position of game in the district.

One thousand two hundred and twenty-five miles of patrol was carried out by the Assistant Game Warden during the year.

The boundary of the Reserve was demarcated where it adjoins the Deka Ranch, and the dispute as to the boundary of the Sinamatela Ranch was settled.

Water Supplies.—Most of the "pans" contained water throughout the year. In addition four successful boreholes have been sunk in the proximity of large "pans" and windmills are being erected so that in future there should be little danger of these important sources of water drying up.

The erection of windmills in the country frequented by elephant present considerable difficulties but the danger of

their destruction appears to have been successfully averted by the construction of wide trenches round the mills and the burying of delivery piping in concrete.

In addition to these windmills, a small dam holding about 7 feet of water was constructed during the year.

There has been a notable absence of concentration of game during the year owing to good grazing and browsing and abundance of water.

This has resulted in comparatively small numbers of animals being seen by visitors.

Buffalo kept to their usual haunts and it was not until November that large herds of Eland were seen. *Elephant*: The usual concentrating of elephant was not noted until October and November but it is estimated that there were at least 750 head in the Reserve at this time.

No carcasses were found during the year and the usual number of calves which is about two or three to every twenty or thirty old animals were seen.

Oryx. The number of Oryx has remained at a satisfactory level and a good number of calves was seen during September.

Giraffe continue to maintain their position as the most commonly observed animal in spite of the fact that they are occasionally killed by lions.

Cape Hartebeeste. Only one Cape Hartebeeste was reported during the year but this was in a district where they have not previously been seen.

Ostrich. The last year's ostrich chicks appear to have perished but there are several well-grown clutches from this year's hatchings.

Roan Antelope have maintained their numbers and *Sable* have steadily increased.

Zebra which became scarce at the end of last year have returned to a certain extent. Game birds had a good year, many of them rearing second clutches.

Wild Dogs are still numerous although efforts have been made to reduce them. *Lions* are uncommon and are not seen frequently. With Ministrial permission a good specimen of Oryx was obtained for the Rhodesia Museum.

One hundred and two visitors entered the Reserve during the year and those desiring to do so were accommodated in two furnished wooden huts.

Rhodes Inyanga Estate.—The estate is now being developed as rapidly as possible into a holiday resort and national park.

To this end additions have been made to the Hotel and two rest-camps which will shortly be roughly furnished and made available for occupation at a small charge, have been erected.

An additional 550 acres of land embracing the Pungwe Falls is to be acquired by purchase.

Experimental plantings of forest trees and berry fruits are being continued.

Many of the exotic forest trees have regenerated naturally. Seedlings of *Pinus radiata* have been noted in areas where locusts stripped the trees two years ago and thus increased the light on the forest floor.

Roadwork has been pressed forward and the road to the Inyangombie Falls is now passable.

The circular drive round Mt. Inyangani is progressing favourably. Part of this work is in the hands of the Roads Department and a sum of £350 was contributed by the Estate towards this work.

Cash revenue collected amounted to £205 5s. and expenditure exclusive of salaries to £775 3s. 6d.

Orchards are in good order and a fair crop is expected. The Manager reports that top working of unprofitable trees carried out in previous years can now be definitely stated to be a success.

Fish.—Approximately 20,000 Rainbow trout and 1,000 Brown trout were released during the year at Inyanga.

A similar number will be released this season. Some good fish have been seen in the streams and spawning appears to have been good.

At Stapleford 10,000 Rainbow trout and 2,000 Brown trout ova were received and hatched on behalf of the local Angling Society and 11,500 were later released in various streams.

Valuable observations are being made on the breeding habits of indigenous fish introduced into "pans" in the Wankie Game Reserve.

Rainfall.—The rainfall recorded at the various stations during the year was as follows:—

Mtao Forest Reserve (two stations), 30.30in. and 35.26in.

It is notable that although these two stations are separated by a distance of 4 miles only, there was a difference of 40 rain-days.

Stapleford Forest Reserve (three Stations) 83.18in., 79.86in., 82.76in.

Wankie Game Reserve	23.75in.
Salisbury Forest Nursery	37.87in.
Gwaai Forest Reserve	30.65in.
Rhodes Inyanga Estate	58.12in.

Publications.—The following articles prepared by this Division were published in the RHODESIA AGRICULTURAL JOURNAL:—

"Annual Report of the Division of Forestry, 1935."

"A Simple Farm Gate."

"Veld Fires. The Forest and Herbage Preservation Act," by E. J. Kelly-Edwards, M.A. Dip. For. (Oxon), Chief Forest Officer.

"Summary of the Game Laws of Southern Rhodesia."

Articles were also contributed by the writer to "Wood Smoke" and the Show Number of the "Rhodesia Herald."

The loyal support of all members of the staff is recorded with appreciation.

Southern Rhodesia Weather Bureau.

AUGUST, 1937.

Pressure.—Mean barometric pressure was well above normal over the whole country averaging 1.5 mb. above in the south to 1.0 above in the north and west.

Temperature.—Mean monthly temperature was below normal.

Humidity and Rainfall.--Slight rains were recorded and the humidity was slightly above normal.

Weather Features.—At the opening of the month pressure was generally low and gradients weak except over the south-east coast. On the 2nd a high appeared over the Cape, and by the 5th the high was central over Transvaal, covering the whole of Southern Africa. Cloudy weather occurred in the south and east on the 3rd and 4th, but the cold was not intense. On the 6th and 7th gradients slackened and temperatures increased, the east wind continuing but moderating.

On the 8th a low formed over the Cape, under the influence of which pressure fell generally until the 11th. The weather was characterised by light winds, warm days and cold nights.

Pressure rose generally on the 12th and moderate E to SE winds blew on the 13th, cloud forming in the south and east. The cloud cleared on the 14th, and weather remained fine until the 17th when an intense high caused an increase in the wind force, followed by guti weather on the 18th. Temperatures were generally low, and drizzle and light showers were widespread.

Pressure fell rapidly and the wind moderated on the 20th, but cloudy weather continued for a few days. Temperatures rose steadily and were about normal by the 23rd.

A further high brought a short spell of cool cloudy weather to the south and east on the 25th, and another on the 29th, although producing less cloud, caused a cold wind throughout the country. The wind was moderating and temperatures rising on the 31st.

PRECIPITATION.

Station	Inches	Normal	No. of days
Angus Ranch	0.03	0.02	1
Beit Bridge	0.00	0.07	—
Bindura	0.04	0.03	1
Bulawayo	0.00	0.02	—
Chipinga	0.43	0.53	5
Enkeldoorn	0.03	0.04	1
Fort Victoria	0.15	0.07	2
Gwaai Siding	0.00	0.00	—
Gwanda	0.00	0.06	—
Gwelo	0.03	0.07	2
Hartley	0.00	0.04	—
Inyanga	0.04	0.08	1
Marandellas	0.00	0.09	—
Miami	0.04	0.07	1
Mount Darwin	0.00	0.03	—
Mount Nuza	1.26	0.86	9
Mtoko	0.01	0.05	1
New Year's Gift	0.15	0.16	2
Nuanetsi	0.00	0.04	—
Plumtree	0.00	0.06	—
Que Que	0.00	0.01	—
Rusapi	0.02	0.10	1
Salisbury	0.03	0.12	1
Shabani	0.13	0.01	2
Sinoia	0.00	0.04	—
Sipolilo	0.06	0.07	1
Stapleford	1.70	0.58	9
Umtali	0.53	0.21	6
Victoria Falls	0.00	0.00	—
Wankie	0.00	0.00	—

AUGUST, 1937

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	Wet Bulb.	Dew Point	Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
ngus Ranch... ...	...	59.9	56.0	53	4.0	76.2	50.2	63.2	82	2nd	44	12th	...	2	...	...	...	...	...	...	...	...
eitbridge...	1,500	61.1	53.8	48	6.1	79.7	50.1	64.9	87	10th	39	2nd	3	1	...	1	65.2	972.4	887.9	...	2.7	...
indura...	3,700	59.4	50.9	43	7.8	75.5	47.9	61.7	79	2nd	38	7th	...	...	...	2	61.7	897.1	886.7	...	2.0	...
ulawayo	4,393	56.9	48.6	40	7.4	71.3	46.1	58.7	77	9th	39	6th	...	8	...	1	58.1	874.9	886.6	873.5	2.5	9.9
ɪipinga	3,685	59.7	53.5	48	6.0	70.7	49.1	59.9	78	2nd	44	15th	...	10	...	...	58.8	898.6	887.7	...	3.2	...
ɪkeldoorn...	4,788	56.3	49.3	43	6.2	69.8	44.1	56.9	79	11th	38	8th	...	13	...	2	56.5	862.5	886.6	...	2.7	...
ɔrt Victoria	3,571	57.5	50.7	44	6.4	72.3	43.3	57.8	81	11th	36	6th	...	7	...	9	58.6	902.1	887.5	...	3.3	...
waai Siding	3,278	56.1	47.9	39	7.2	80.9	41.9	61.4	87	13th	34	1st	2	...	...	11	...	909.8	885.5	...	0.7	...
wanda...	3,233	57.9	50.7	44	6.7	73.3	46.3	59.8	81	10th	38	1st	...	7	1	6	60.1	913.0	887.2	...	3.0	...
welo	4,629	56.0	48.8	42	6.3	70.0	43.9	56.9	79	11th	36	1st	...	12	...	7	57.2	867.5	886.8	...	2.3	...
artley...	3,879	59.0	50.4	42	7.8	76.1	44.2	60.1	83	13th	38	6th	...	1	...	7	60.2	891.0	886.3	...	1.5	...
yanga...	5,503	57.1	47.5	37	8.4	67.2	43.9	55.5	76	10th	32	9th	...	23	...	6	54.7	...	...	...	1.8	...
arandellas	5,453	55.1	48.1	41	6.0	67.8	44.8	56.3	76	11th	39	6th	...	19	...	1	55.8	...	...	...	2.4	...
iami	4,090	60.8	52.5	45	8.0	74.3	47.4	60.9	79	11th	41	1st	...	...	...	...	60.2	883.7	885.8	...	0.9	...
ɔunt Darwin ...	3,179	62.1	54.5	49	7.5	76.7	47.5	62.1	80	2nd	38	7th	...	...	...	4	62.6	913.1	...	...	2.4	...
ɔunt Nuza	6,668	48.2	43.9	39	3.4	55.9	42.2	49.1	64	2nd	38	5th	...	31	...	4	47.9	805.2	886.6	804.5	6.0	...
ɫoko	4,141	59.8	51.3	43	8.0	71.8	49.3	60.5	76	10th	43	6th	...	5	...	...	60.2	882.9	886.5	...	1.1	..
ɛw Year's Gift...	2,690	59.7	55.3	52	4.3	75.8	48.9	62.4	83	11th	39	8th	...	2	...	1	...	...	...	...	...	8.4
ɪanetsi	1,581	61.6	54.8	49	6.8	79.8	47.7	63.7	87	11th	36	2nd	4	1	...	2	...	970.0	888.5	...	2.9	...
ɪmtree	4,549	59.6	48.9	38	9.8	71.2	49.1	60.1	76	9th	41	6th	...	8	...	...	59.6	869.7	886.3	...	1.1	...
.e Que	3,999	58.7	49.7	41	8.2	74.9	46.5	60.7	81	11th	38	6th	...	2	...	2	60.7	887.2	886.4	...	1.0	...
ɪsape	4,648	55.7	49.1	43	5.6	69.4	43.1	56.3	78	11th	36	7th	...	14	..	6	56.1	..	...	...	2.0	...
lisbury	4,831	58.0	49.4	42	7.6	72.2	45.3	58.7	79	11th	39	7th	...	6	...	1	58.5	860.9	886.0	859.5	1.0	9.2
abani...	3,131	59.7	51.8	45	7.5	73.7	47.9	60.8	79	9th	41	9th	...	5	...	...	60.5	...	...	...	3.3	...
ɪoia	3,795	60.6	51.5	44	8.4	77.0	42.3	59.7	83	10th	34	7th	...	...	...	13	60.3	893.7	886.4	...	0.7	...
ɔlilo	3,876	62.5	52.6	44	9.7	74.0	48.5	61.3	79	3rd	38	7th	...	3	...	1	...	889.8	885.5	...	1.1	...
ɪpleford	5,304	51.8	48.7	46	2.6	61.9	39.3	50.6	69	2nd	29	1st	...	31	...	13	49.9	847.2	887.3	...	4.3	...
ntali...	3,672	59.9	53.7	49	6.0	73.5	49.0	61.3	82	2nd	41	7th	...	3	...	...	59.8	898.8	887.5	...	3.3	...
ɔtoria Falls... ...	3,009	61.2	51.6	41	9.0	82.7	46.2	64.5	88	12th	35	7th	4	...	...	7	...	917.5	885.5	...	0.7	...
ɪnkie	2,567	64.2	52.1	41	11.8	85.3	54.9	70.1	89	12th	46	1st	16	...	...	...	70.0	932.6	885.3	...	0.8	...

Southern Rhodesia Veterinary Report.

JULY, 1937.

AFRICAN COAST FEVER.

Disease was diagnosed on the Chipinga Commonage in the Melsetter Native District.

FOOT AND MOUTH DISEASE.

A slight extension was discovered on Crown Lands east of the Chiredzi River at the Chongwe tank area in the Ndanga Native District.

TUBERCULIN TEST.

Five bulls, three heifers and one calf were tested upon importation with negative results.

MALLEIN TEST.

Twenty-nine horses and one donkey were tested. No reactions.

IMPORTATIONS.

From the Union of South Africa: Horses, 29; Donkeys, 1; Bulls, 5; Heifers, 3; Calves, 1; Sheep, 985.

EXPORTATIONS.

To the Union of South Africa: Oxen, 520; Cows, 49.

To Northern Rhodesia: Bulls, 1; Cows, 100; Pigs, 1; Sheep, 56.

To Portuguese East Africa: Oxen, 12.

EXPORTATIONS—MISCELLANEOUS.

To the United Kingdom in cold storage: Chilled beef quarters, 8,919; frozen beef quarters, 6,181; frozen boned beef quarters, 5,661; chilled porkers, 101; kidneys, 3,718 lbs.; tongues, 15,939 lbs.; livers, 27,288 lbs.; hearts, 8,184 lbs.; tails, 3,252 lbs., skirts, 3,978 lbs.; shanks, 13,704 lbs.

Meat Products—From Liebigs Factory: Corned beef, 76,360 lbs.; meat extract, 29,954 lbs.; beef powder, 76,538 lbs.; beef fat, 22,842 lbs.; meat meal, 70,000 lbs.

B. A. MYHILL,
Actg. Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-37.

Monthly Report No. 57.
AUGUST, 1937.

A few winged swarms of the Red Locust (*Nomadacris septemfasciata*, Serv.) have been reported from the north of the Colony during the month of August, the districts included being Salisbury, Sebungwe, Lomangundi and Umtali. The swarms have all been described as "large."

No damage to crops has been reported.

RUPERT W. JACK,
Chief Entomologist.

NOTICE

The Agricultural Journal of S. Rhodesia

is issued by the Department of Agriculture, and can be obtained upon application to the Editor. The Annual Subscription, which must be paid in advance, is 5/-, and payment may be made by any means other than by stamps.

A 10/- note will cover the subscription for two years.

Persons residing outside Southern and Northern Rhodesia may become subscribers by paying 2/- in addition to the subscription, to cover postage.

If payment is made by a cheque drawn on a bank outside Rhodesia, commission must be added.

All cheques and postal notes must be made payable to the Secretary for Agriculture and Lands.

Date..........................19......

To the Secretary,
Department of Agriculture and Lands,
Salisbury.

Please enrol me as a subscriber to the "Rhodesia Agricultural Journal" for one year from....................................

19......, *for which I enclose*...

Name..

Full Postal Address......................................

....

....

Please write distinctly

THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.
(Assisted by the Staff of the Agricultural Department).

PUBLISHED MONTHLY.

Subscription: 5/- per annum; payable to the Accountant, Department of Agriculture, Salisbury.

VOL. XXXIV.] NOVEMBER, 1937. [No. 10

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Binding this Journal.—Since the beginning of this year readers will have noticed that the Journals have three holes punched near the inside margin to facilitate keeping them together when each volume is complete. Arrangements have now been concluded with the Art Printing Works, Box 431, Salisbury, to supply cardboard covers for this purpose. The two covers will have cloth hinges and will be punched to match the holes in the journals. These are put in position and the whole lot tied together with string. The gummed cloth strip which is supplied is then stuck over the back and the label, printed with the name and number of the volume, is stuck in position and the volume is safely bound together. The cost of the cover, including the gummed strip and printed label, will be 1s. 6d. at the Art Printing Works, or 1s. 9d. post free.

Weather Forecasts.—A weather forecast and description of general weather conditions is now included in the week-day programmes of the Post Office broadcast, and a forecast in the Sunday morning programme.

Similar forecasts and descriptions are published in the daily Press. The telegraphic forecasts will be resumed on November 1st. The forecasts will be handed in at the Salisbury Post Office at 2 p.m. on week-days (excluding public holidays) for transmission to Post Offices and Postal Agencies in districts from which applications for the service have been received. These forecasts will be concerned mainly with the probability of rain.

Management of Tobacco Soil in Canada.—Mr. F. A. Stinson, writing in a recent number of "The Lighter," states:—

"The land should be packed with a cultipacker as soon as it has been ploughed. Although a certain amount of cultivation is necessary in preparing the soil before applying the fertiliser, it should be remembered that each cultivation destroys a part of the desirable granular structure which is built up gradually in undisturbed soil. Where practical, the spring toothed cultivator or harrow proves more satisfactory than the disc harrow, as it leaves the soil less subject to blowing. Since the texture structure of the sandy soils is not highly developed, unnecessary cultivation should be avoided.

"This applies also to cultivation after transplanting. Indeed, preliminary tests on flue-cured land on the Experimental Sub-station at Delhi indicate that only sufficient cultivation should be given the flue tobacco crop to keep it free of weeds. The value of a dust mulch for conserving moisture has been over estimated. Crop yields have been higher where the soil was left undisturbed than where a dust mulch was maintained by cultivating every week during dry weather. Each cultivation exposes additional soil to the surface, permitting of further drying out and oxidation of organic matter which is usually low. Cultivating tobacco while the soil is wet is not only harmful to soil structure but facilitates the spread of the mosaic disease.

"Tests are under way at Delhi to gain further information regarding the use of various crops, rotations, methods of cultivation, and other related practices for maintaining soil productivity."

Notice to Growers of Dark Fire-cured Tobacco.—The attention of growers of dark fire-cured Virginia tobacco is drawn to the fact that it is necessary for them to make application for registration each year in terms of Section 19 of the "Tobacco Marketing Act, 1936," as amended.

Application for registration in respect of the season 1937-38 shall be made on or before the 30th November, 1937.

No grower shall be entitled to registration who does not so apply.

Applications shall be made in the prescribed manner as under:—

The Secretary,
Department of Agriculture and Lands,
Salisbury.

I hereby apply, in terms of Section 19 of the "Tobacco Marketing Act, 1936," as amended, to be registered as a tobacco grower.

(1) Name of Grower (in block capitals)..............................

(2) Name of Farm (in block capitals)..................................

(3) Postal Address (in block capitals)................................

(4) Registered No. previously allotted...............................

(5) Type of tobacco grown...

(Sgd.)..

Date..............................193...

Reduction in Railage Rates for Farmers moving to a new area.—Information has recently been received from the General Manager of the Beira and Rhodesia Railways that reduced rates have been approved to assist farmers transferring their farm operations from one part of the territory served by the railways to another.

The reductions apply to the following classes of farm goods:—

(*a*) Livestock as defined in Clause No. 147 of the Goods Tariff Book, loose, in trucks, will be charged at one half the full ordinary public rates, subject to a minimum charge of £1 13s. 0d. per short truck or £3 6s. 0d. per bogie truck. Full cleansing fees will be payable.

(*b*) Small animals, in cases, cages, crates, hampers, etc., will be charged at one half the ordinary public rates.

(*c*) Vehicles for farm work (not motor cars) will be charged at one half the ordinary public rates, subject to a minimum charge of £1 13s. 0d. per short truck or £3 6s. 0d. per bogie truck.

2. The above rates will be allowed only on production of a certificate from the Department of Agriculture and Lands to the effect that the consignor is transferring his farming operations in the manner indicated.

3. In respect of furniture and household effects, farmers can avail themselves of the concessionary rates already in operation.

Fat Stock Show and Sale.—A fat stock show and sale has been arranged by the Bulawayo Agricultural Society to take place on the Show Grounds, Bulawayo, on November 19th, 1937. It should be noted that entries close on November 13th. The following classes have been arranged, and the entry fee is half-a-crown, except for Classes 4, 5 and 6, for which it is 5s.:—

Class 1.—Best Slaughter Ox: £5, £2 10s.

Class 2.—Best Two Slaughter Oxen: £5, £2 10s.

Class 3.—Best Three Slaughter Oxen: £5, £2 10s.

Class 4.—Best Five Slaughter Oxen, 6 teeth and under: £10, £5, £2 10s.

Class 5.—Best Five Slaughter Oxen, open: £10, £5, £2 10s.

Class 6.—Best Five Chillers: £10, £5, £2 10s.

Class 7.—Best Slaughter Cow: £3, £1 10s.

Class 8.—Best Five Slaughter Sheep (Rhodesian bred): £3, £2, £1.

N.B.—No second prizes will be awarded unless there are 3 or more entries and no third prizes unless there are 5 or more entries.

The following have kindly donated the above prizes:—Mr. W. B. Dawson (Class 4), Messrs. C. Salomon and Kaufman, Ltd. (Class 5), Messrs. Landau Bros., Ltd. (Class 6), Mr. D. A. Blumberg (Class 2), His Worship the Mayor of Bulawayo, Sir George Johnson, J.P. (President), Capt. Hon. F. E. Harris, D.S.O., M.P., Mr. J. H. Bookless, Mr. S. S. Grossberg, Rhodesia Cold Storage, Ltd.

The sale will take place immediately after the judging.

Notes from the Game Reserve.—Twenty-five people visited the Game Reserve during the month. Only five cars handed in lists of game seen, but these, travelling a total distance of 405 miles, reported seeing 1,127 head divided among 17 different species. Included among this total were over 80 elephant which, owing to the drying up of the smaller pans, are now concentrating round the windmills in the more developed portions of the Reserve. Giraffe are widespread throughout the area and the herd of eland which has recently frequented the neighbourhood of the Homestead is still in evidence. Wildebeeste have unaccountably disappeared, and this may be due to a seasonal migration. Rangers and labourers took part in a search for Mr. Ashby who was lost when flying from Bulawayo to Livingstone, owing to reports that he had been seen near Dett. He was eventually found in the Plumtree district. The water supply is holding out satisfactorily in the larger pans.

Veterinary Research Department

P.O. Box 657, SALISBURY.

VACCINES, REMEDIES, ETC., FOR THE INOCULATION AND TREATMENT OF LIVESTOCK.

The following vaccines and remedies will be supplied, postage and rail carriage paid, *on receipt of cash or cheque,* payable to the Director of Veterinary Research :—

1. QUARTER EVIL VACCINE.

For cattle ... ... 3d. per dose.
For sheep ... ... 1d. per dose.

(Supplied in bottles containing 10, 20, 40, 80 or 100 doses).

2. INFECTIOUS ABORTION VACCINE ... 3d. per dose.

3. REDWATER and GALLSICKNESS VACCINE 1/- per dose.

(Minimum supply 5 doses; issued for use only on calves under 9 months; must be used within 48 hours of preparation).

4. HORSESICKNESS VACCINE ... ... 6/- per dose.

(Issued only during advertised period, usually June-October).

5. BLUE TONGUE VACCINE, FOR SHEEP 1d. per dose.

(Issued in bottles containing 12, 24, 48 and 96 doses).

6. CHICKEN-POX VACCINE FOR POULTRY. 3/- per 50 doses.

(Must be used within 7 days of issue).

7. WIRE WORM REMEDY (Powder) ... ... 1/- per tin.

(One tin contains 100 doses for adult sheep).

Set of spoons for use with above 6/-
Dosing bowl for use with above ... ... 9d.

8. NODULAR WORM REMEDY ... ... 1/6 per tin.
(One tin contains sufficient powder for the single treatment of 100 adult sheep; double treatment is advised).

Set of spoons for use with above 6/-

Dosing bowl for use with above ... ... 9d.

Valuable cattle can be inoculated for redwater, gall-sickness, and quarter evil at the Veterinary Research Station, the charge being £5 0s. 0d. per head for Rhodesian or South African bred animals and £7 10s. 0d. per head for animals imported from other countries. This charge includes the cost of food and attendance for the duration of the inoculation period, which is approximately 6 weeks to 2 months.

Pipettes and preservative for the collection of blood samples for contagious abortion testing of cattle and bacillary white diarrhoea and fowl typhoid testing of poultry are supplied on request.

NOTE.—No refund will be allowed for vaccines, etc., returned.

Establishing Rhodes Grass

By S. D. Timson, M.C., Asst. Agriculturist.

Three different methods for establishing Rhodes grass are suggested below. It is thought that those farmers who are intending to establish this grass during the coming season may care to test one or more of them.

The first method has already been tried with success by one farmer, but the others have not been used at present so far as the writer is aware.

In making these suggestions three main objects have been aimed at, since it is considered that they are, each of them, of the greatest importance in the successful establishment of this grass. They are as follows:—

(1) The preparation of a very fine tilth, and a very firm seed bed, free from weeds;

(2) The supply of humus cheaply to the soil, for the benefit of the Rhodes grass;

(3) The prevention, or partial prevention, of the loss of the top soil by wash due to rain storms falling when the soil is in a fine state of tilth.

So great is this latter danger that farmers are recommended not to attempt the establishment of Rhodes grass on a large scale, unless or until the land has been efficiently protected from erosion by contour ridging.

Method 1.—Sow sunnhemp (Somerset) at 12 lbs. per acre as soon as a really fine tilth can be obtained, and cover in the usual way. Then sow the Rhodes grass and cover lightly with a brush harrow, and roll (only if the soil is dry, of course). When the sunnhemp is about two and a half to three months from germination, reap, and turn into hay or compost. Broadcast 100 lbs. per acre of sulphate of ammonia after reaping the sunnhemp.

Method 2.—Sow the Somerset sunnhemp dry just before the main rains break, at the rate of 20 to 40 lbs. per acre (the higher rate for preference) on an unploughed maize stubble. The soil may be disc-harrowed before sowing, and the seed covered in the usual way.

As soon as is practicable after the sunnhemp is eight weeks old, reap it and make into hay or compost. Immediately it is off the land, disc-harrow lightly twice and drag harrow. Sow the Rhodes grass and cover lightly with a brush-harrow, and roll the land if possible after sowing.

One hundred pounds per acre of sulphate of ammonia should be broadcast before disc-harrowing the sunnhemp stubble.

Method 3.—Broadcast Somerset sunnhemp at 20 lbs. per acre and reap it for seed when mature.

In the following season disc-harrow and drag-harrow the sunnhemp stubble to a fine tilth just before the main rains break. As soon after the rains have broken as the soil is in condition, sow the Rhodes grass, cover lightly, and roll it if possible.

Broadcast one hundred pounds per acre of sulphate of ammonia before sowing the grass.

In sowing Rhodes grass it is always advisable, in order to ensure an even distribution of the seed, to employ the following simple method. Mix the seed with two or three times its bulk of dry sifted soil or sand. Divide the mixture into two equal portions, and sow one portion across the field, and then sow the other portion at right angles to the direction in which the first was sown.

With regard to the rate of seeding, five to ten pounds per acre of imported seed will suffice, according to the germination capacity and the fertility of the soil, and the local conditions of rainfall.

If local, unguaranteed, seed is used, it will be advisable to carry out a germination test, and as a guide it may be suggested that if the germination percentage is ten to fifteen per cent., then twelve to eighteen pounds of seed, or even more per acre, will be required.

The Production and Handling of Milk and Cream.

By THE DAIRY BRANCH.

"Quality is never an accident; it is the result of good workmanship, conscientious effort and intelligent management."—(National Butter and Cheese Journal, 10th January, 1937).

(*Continued.*)

3. **Clean Milking.**—For reasons previously given, the milker may be a serious source of contamination. No one who is suffering from any contagious or infectious disease should be allowed to work in the cow shed or dairy. Milking operations should always be supervised by the farmer, who should insist on the milk boys wearing clean clothes or overalls, which should be frequently washed, and milk boys should also wash and dry their hands before milking, and in between milking each cow, as illustrated in fig. 4. Very few natives milk dry handed, so that a supply of clean water should be provided for moistening the hands of the milker; alternatively a little vaseline can be applied to the teat as a lubricant. The practice of dipping fingers into the milk or milking on to the fingers for moistening the teats as practised by so many native milkers, is most unsanitary and should not be tolerated.

The practice of rejecting the first few drops of milk is to be recommended for, as previously stated, the "fore-milk" invariably contains large numbers of bacteria; this milk need not be wasted, but may be collected in a special pail and fed on the farm. It is quite possible to train intelligent natives to milk in a cleanly manner, but a great deal depends on the facilities given by the farmer to the natives for making or keeping themselves clean. A native can hardly be expected

to keep himself clean and to produce clean milk if he is not provided with suitable quarters and facilities for washing himself and his clothes, etc.; it is also a physical impossibility for natives to keep themselves clean if they are compelled to milk in a dirty kraal.

It is also necessary for the production of clean milk that the cows should milk without their calves. Fortunately the hand-rearing of calves is rapidly becoming a more general practice amongst Rhodesian dairymen, although the spectacle of a cow being milked with her calf in attendance is still very common in this territory. Needless to say there is not much point in cleaning the cow's udder and teats if, subsequently, the calf has to be allowed a few preliminary sucks before

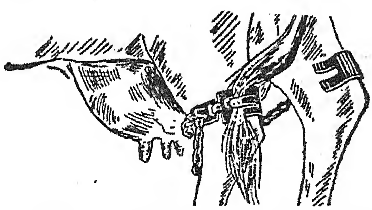


Figure 5.—Showing method of applying cow hobbles.

milker, particularly if the cows have sore of chapped teats—then cow hobbles of the type illustrated in figure 5 should be used. Ropes or reims—see figure 6—should not be used for this purpose, as they cannot possibly be cleaned or be kept clean. Cow hobbles of the type shown can be purchased for a few shillings, and they possess the obvious advantage of being

easily cleaned and can at least be scrubbed and dropped into boiling water without being damaged. Needless to say, the milker should place the hobbles on the cow he intends to milk before, not after, he washes his hands. Milking stools, if used, should be kept clean by frequent scrubbing.

Most of the dirt that gets into milk falls from the cow into the pail at milking time, and contamination from this source can therefore be very considerably reduced by the use of the so-called "hooded," or covered-top milk pails, which expose a very much smaller surface for the entrance of dirt than the ordinary open top pail; the openings in some of these pails are fitted with strainers to catch particles of dirt; an alternative practice is to milk into a bucket covered with a straining cloth. Figure 7 illustrates different types of milking pails. Milk buckets must be strongly constructed and be welded—not soldered—together and be seamless, contain no rivets and be smoothly and heavily tinned throughout. Milking pails of satisfactory design and construction can now be obtained locally at reasonable prices, and there is therefore no excuse for any person to milk into petrol or oil tins or other unsanitary receptacles such as the little iron pail so commonly used as a milk bucket on Rhodesian dairy farms.

Milking Machines.—Within recent years milking machines have been greatly improved and machine milking is rapidly displacing hand milking in dairying countries such as New Zealand.

In this territory good native milkers are scarce, as many a farmer with a high grade dairy has found to his cost, and there is little doubt therefore that in spite of the fact that milking machines are somewhat costly to instal, they may ultimately become an important factor in advancing the dairying industry in this Colony; in fact, as our dairy herds improve milking machines may become a necessity. Experiments have indicated that they have no appreciable effect on milk yield or on the composition of the milk and that, provided the machines are properly cleaned and sterilised, a milk very low in bacterial content may be produced.* Figure 8 shows a cow being milked by machine.

If the hooded type of milk pail is used and the cows are clean when milked, then the amount of dirt falling into the milk should be reduced to a minimum and subsequent straining, with the object of removing particles of manure or other foreign matter from the milk, should not be necessary. In actual practice, however, it is usually advisable to strain the milk, and for this purpose tinned metal strainers, incorporating the use of cotton wool pads, are recommended; one type of such strainer is illustrated in figure 9. These cotton wool pads allow the milk to pass through somewhat slowly, and it is advisable therefore to have several strainers in use so as to avoid delay; the pads should also be frequently replaced by new ones, as they soon become clogged with dirt, and hence the milk cannot pass through; each pad is used once only. It should be noted that straining does not remove bacteria, except those organisms which adhere to the particles of dirt left on the strainer; straining is not therefore a remedy for faulty methods of production. An examination of the straining pads, however, will indicate to the farmer whether the milking operations are being carried out in a cleanly manner, and will frequently lead—particularly if slime is observed on the filter pad—to the detection of unsuspected cases of udder trouble, mastitis, etc. Strainers may, however, become an important source of contamination if they are not properly cleaned and sterilised. As milk can rapidly absorb odours from its surroundings, it should not be allowed to remain at the milking shed any longer than is necessary. In fact, the sooner the milk can be removed to the dairy the better. It is advisable

*Annual Report, Dairy Research Institute, Pretoria, 1930-31.

to have special cans for the collection of the milk during milking; the milk can be strained into these cans and the latter, when full, should then be removed without delay to the dairy. Every care should be exercised to prevent flies from getting into the cans, milk pails or strainers during milking. Figure 10 illustrates one type of container commonly used for collecting milk at the milking shed; the ordinary can is, however, to be preferred for this purpose, as it has a lid.

4. **Clean, Sterile Utensils.**—As previously stated, utensils which are not properly cleaned and sterilised are usually the most serious source of bacterial contamination on the average dairy farm. The dairyman frequently fails to grasp the fact that a utensil may be clean without being sterile and that it is possible for a bucket or can which has been thoroughly scrubbed and cleaned and which has a bright, dirt-free surface to be yet a source of bacterial contamination. All utensils and apparatus which come into contact with milk and cream should be thoroughly cleaned and sterilised; for this purpose very little is required in the way of equipment, except in the case of the larger dairies, where the installation of a small boiler and a steaming cabinet is usually advisable. In the cleaning and sterilisation of dairy utensils it is necessary first of all to bear in mind the fact that dirty apparatus cannot be effectively sterilised and that it is therefore essential that all remnants of milk and cream, dirt and other matter should be completely removed from all dairy equipment before sterilisation takes place. Secondly, it should be remembered that rusty utensils or equipment and containers which have become dented or battered from continual use are almost impossible to clean and sterilise.

The procedure to follow in cleaning dairy apparatus is, first of all, to rinse the equipment immediately after use with cold or lukewarm water; hot water should not be used for the first rinsing, as it tends to bake the remnants of milk on to the apparatus; after the utensils have been rinsed with cold or lukewarm water they should be scrubbed with brushes and hot water containing 2% to 3% of washing powder; the latter serves to remove the films of fat or grease from the utensils. Soap or greasy powder should not be used for washing dairy equipment, nor should any cloths be used for this purpose,

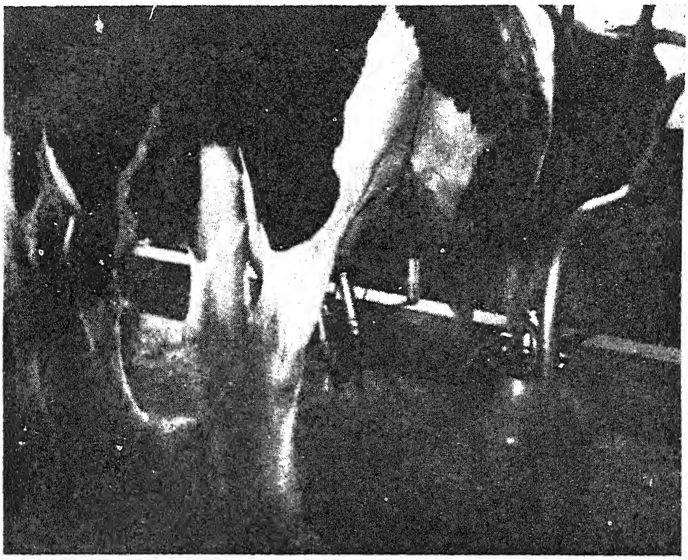


Figure 8.—Cows being milked by a milking machine.—(Sunnyside Farm, Gwelo.)

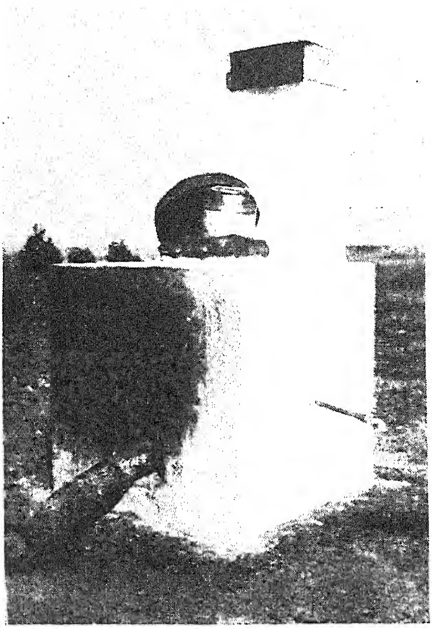


Figure 11.—Petrol-drum steriliser containing boiling hot water in which utensils are immersed after being cleaned.—Quinnington Farm, Salisbury).

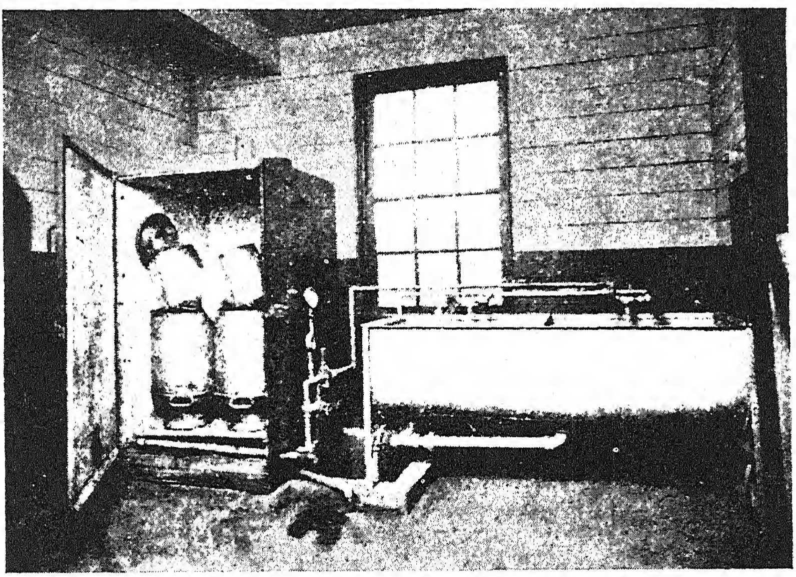


Figure 12.—Steaming cabinets for sterilising utensils with tank for preliminary rinsing and washing.

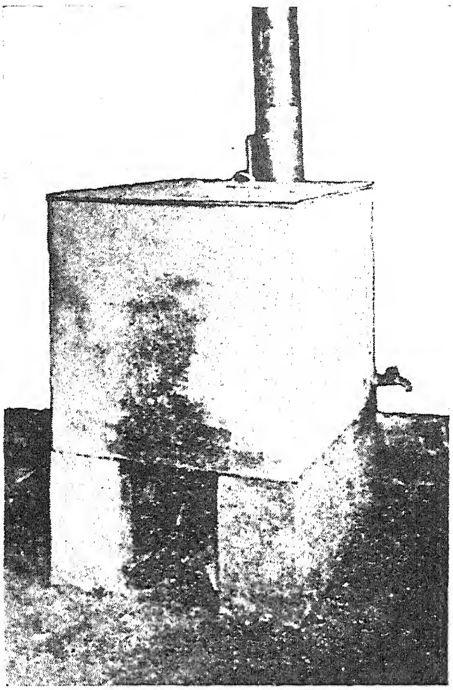


Figure 13.—Galvanised iron box steriliser (suitable for small dairies).

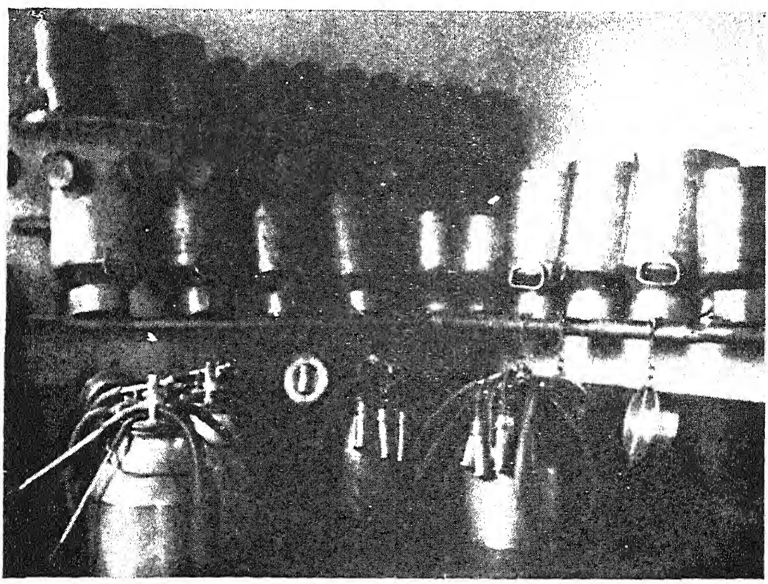


Figure 14.—Dairy fitted with racks for storage or draining of utensils.—(Sunnyside Farm, Gwelo.)

as they tend to smear the grease or dirt on the utensil; they are also impossible to keep clean. The necessity for a clean, safe water supply for washing and rinsing utensils, etc., has already been emphasised. After being scrubbed with brushes the utensils should be rinsed in hot water to remove the dislodged dirt and washing powder solution.

The apparatus should then be sterilised; this may be accomplished in one of several ways, depending on the facilities available and the number and size of the utensils to be treated. The apparatus may be submerged in boiling water or be steamed, or it may be treated with chemical sterilisers. Generally speaking, however, steaming is the most satisfactory method of sterilising dairy equipment. For small dairies, however, where there are only a few utensils to be treated, a convenient arrangement for cleaning and sterilising equipment can be made by cutting two 80 gallon petrol drums in half and placing the four halves in a row for use as follows: the half drum at one end can be used for the preliminary rinsing of the utensils in cold or lukewarm water, the next container is used for scrubbing the utensils with brushes and hot water, and the third container is then used for the final rinsing; the fourth container should be built over a fire box and contain boiling hot water in which the utensils, after the final rinsing, are sterilised by immersion for a period of half an hour. Figure No. 11 shows one type of petrol drum steriliser suitable for small dairies.

For dairies operating on a larger scale a galvanised iron round bottom vat, divided into two or three compartments with water laid on, is necessary for rinsing and cleaning utensils. In this case a separate room should be provided for washing and sterilising the utensils; in the case of a small dairy these operations can be quite easily done outside. As previously stated, farmers dairying on a large scale will find it advisable to instal a small boiler (4 to 7 h.p.) and a steaming cabinet for the sterilisation of utensils and equipment. Steaming cabinets can be made of various materials: wood, galvanised iron, reinforced concrete, etc., or any material which is not easily damaged by steam and of which a tight box can be constructed, may be used. Utensils such as cans, pails, etc., are placed in the cabinet in an inverted position, usually on

racks, and steam from the boiler is then liberated under the utensils from a perforated pipe, usually placed on the floor of the cabinet. The inside temperature of the cabinet and utensils should be raised to about that of boiling water and be maintained at this level for a period of half an hour to an hour. Figure No. 12 illustrates a steaming cabinet and galvanised iron rinsing and washing vat. In the absence of a boiler, dairy utensils can be quite effectively steamed in a galvanised iron box steriliser. This consists of a box or tank of galvanised iron (No. 16 or No. 14 gauge) with a tightly fitting lid, mounted over a brick fire box (see fig. 13); an extra piece of iron should be placed over the fire to prevent injury to the box or tank.

An inch or so of water is placed in the bottom of the tank and the utensils are then set in an inverted position on a slatted rack two or three inches above the water. The lid is then put on and a fire started underneath the tank to boil the water; the steam which is then generated raises the inside temperature of the box and the utensils to about that of boiling water; steaming should be continued for about an hour. This box steriliser may also be used to heat water for washing utensils; it should be provided with a tap so that it can be drained from time to time.

Dairy equipment may also be sterilised by means of certain chemicals, those commonly used being chlorine compounds, *i.e.*, sodium hypochlorite, chloride of lime, etc.; some of these compounds are now prepared commercially in liquid or powdered form and are used quite extensively by creameries, cheese factories and milk distributing plants. There is no reason why they should not be used by the dairy farmer, provided that they are used as sterilising agents and not as "cleansers," *i.e.*, the equipment must be thoroughly cleaned before the sterilising agent is applied, otherwise the latter loses a great deal of its effectiveness. These chemical sterilising agents are usually applied to equipment in cold solution, although there are certain preparations which may be used in either hot or cold water. Care must be exercised in using these sterilising agents on metal equipment, as prolonged exposure of metallic surfaces to the action of chlorine results in the metal becoming tarnished. The sterilising agent should be used immediately the equipment has been cleaned.

Commercially prepared sterilising agents are usually supplied complete with full instructions as to the strength of solution to be used and the manner of application, etc.

Whatever method of sterilisation is practised it is essential that all utensils, unless they can be dried in the steriliser, should be placed, immediately after sterilisation, to drain and dry, in a clean, dust-free, sunny place, protected from flies and away from all odours, etc. Drying the utensils after sterilisation prevents rust and retards bacterial growth; if it is not possible to find a sunny dust-free corner, then the utensils should be placed in the dairy. The use of towels, cloths or rags for the drying of utensils should not be permitted, as this will only cause recontamination of the equipment. In fact, the wise dairyman will prohibit the use of all cloths or rags in his dairy.

5. **Elimination of Flies.**—As previously stated, flies may easily be a very serious source of contamination, and every effort should be made, therefore, to eliminate this pest. The eggs of the house fly are laid in any decomposing material and under conditions of warmth the maggots hatch out and emerge as flies in from eight to ten days' time. The most important fact about the hatching of the egg and the growth of the maggot is that the maggots cannot thrive in the absence of moisture. If the litter from the cow stable is removed and spread out it quickly dries, and therefore the growth of the maggots is inhibited. If the dairy cows are run in a paddock overnight, as they should be, there cannot be much manure to remove from the milking shed and the number of flies which are hatched out can be kept in check. It is obvious that very little can be done as regards control if, as is so often the case, manure is allowed to accumulate in close proximity to cow stables or dwelling houses.

A method of control which is recommended consists of hanging up branches in the stable and spraying them every few days with a mixture of arsenite of soda (half a pound), sugar (four pounds) and water (four gallons). The branches must, of course, be out of the reach of the cattle, and care must be taken that none of the solution can drop on to the food.

Another fly, similar in many respects to the common house fly, is very prevalent. The stable fly, as it is often

called, is a blood-sucking insect, and therefore is not controlled by the poisoned bait method. The only method by which this species can be combated is by the removing of all manure, rotting bedding, etc., in which it can be bred. Like the maggot of the house fly, the stable fly maggot cannot hatch out without moisture being present. The more the manure is spread out and dried, the more unlikely it will be for the fly pest to increase. The importance of the suppression of the stable fly cannot be stressed too strongly. These, as has already been explained, are blood suckers, and where they abound the cows are restive and their milk production suffers in respect of quantity and quality.

6. **The Dairy.**—The size and type of building required as a dairy will depend on the quantity of milk handled and the purpose for which it is used. If the milk is supplied to a milk distributing plant or to a cheese factory, or if it is separated and the cream sent to a creamery then a dairy consisting of a single room measuring 12 feet by 14 feet would probably be large enough; if, however, the milk is bottled on the premises or if butter or cheese is made, then at least one extra room should be provided. The dairy should preferably be a separate building and should also, in terms of the dairy regulations previously referred to, be situated at least 100 feet away from any milking shed or kraal and 100 yards away from any piggery or manure pit, etc. It should also be placed so as to allow of adequate ventilation and drainage, and it must be provided with a ceiling of some description and have a cement floor and be fly and insect proof.

It is obviously a great advantage if water can be laid on to the dairy; an abundant supply of hot water should in any case be close at hand for cleaning and sterilising purposes. In the case of the larger dairies a separate room or shelter should be provided for cleaning and sterilising equipment; racks or removable shelves should be provided in the dairy for the storage of utensils, apparatus, etc. (see figure 14): nothing except dairy produce and dairy equipment and supplies should be kept in the dairy; the latter should not be used as a store room for fruit, vegetables, meat or any other material likely to impart flavours and odours to milk and cream.

(To be continued.)

COMPOST

By S. D. Timson, M.C., Assistant Agriculturist.

Introductory Note.—The following article includes all the information already published in this Journal concerning compost, and the opportunity has been taken to add to it, and in some cases to revise it in the light of local experience.

The process is essentially a simple and elastic one from the practical farm stand point, but the desirability of assisting farmers to adjust it to suit their own particular conditions has forced the writer to elaborate certain aspects so that they may understand how to do this.

The farmer who does not want to know what happens inside the compost heap, and is not particularly anxious to achieve a perfect product in the minimum time, need merely read those sections describing the actual handling of the materials or the proportions of them required.

The writer has found, however, that many farmers are also keenly interested to understand what is happening during the process of decomposition, so that they can the more intelligently utilise the resources of their farms in the way of raw materials to the best possible advantage, and for this reason he has included a brief description of the processes of decomposition of the organic matter and a discussion of the ways and means of speeding up or retarding those processes and making them as economical as possible.

The article has therefore been arranged in sections with the hope that readers can find what they require and neglect the rest without waste of their time.

Section III. deals with a suggestion the writer makes for composting the sunnhemp crop, with the object of reducing the proportion of land idle under green-manure.

Definition.—Compost is the product obtained by the rotting of organic waste materials, chiefly vegetable in origin, by the action of fungi and bacteria, with the ultimate formation of humus.

The origin of Compost.—The employment of compost in agriculture is no new thing, since a method for its manufacture from animal droppings and various crop wastes is described by Ibn-el-Awam in his book on Nabathean Agriculture written in the 6th century.

Marcus Cato, 234-149 B.C. relates the Roman practice in composting farm wastes, and urges the farmers, on farms unable to support livestock, to collect all the crop wastes, leaves and weeds from hedgerows, ferns and sweepings, and mix all these with sewage and straw in a pit.

From ancient times too the fertility of the soil in China has been maintained at a high level by the use of compost made from animal and vegetable wastes, or green crops, fermented in layers with mud from the canals and rivers. Every scrap of organic waste is preserved for this purpose. Nothing is wasted.

The research of Hutchinson and Richards demonstrated that crop wastes could be composted with only inorganic sources of extra nitrogen, and this resulted in the placing on the market of the Adco process. The obstacles to this process being generally adopted in Rhodesia have proved to be (1) the necessity for an artificial water supply, (2) the necessity for using materials which are not obtainable on the farm and are rather costly.

Sir Albert Howard, and his co-workers, at Indore, later worked out and introduced a method of composting crop wastes in a reasonably short time (three months), and without the need to purchase any materials from off the farm.

The modifications and improvements on this method worked out by Jackson, Wad and Panse, which simplified the making of compost from crop wastes with the use of rain only as the source of moisture, and which introduced the ingenious method of providing additional nitrogen supplies by growing a legume on the heaps, resulted in a simplified process, which fits in admirably with the requirements of Rhodesian agriculture. This process, with some modifications by the writer to suit local conditions, was published in the February, 1936, issue of this Journal.

Since then many farmers all over the Colony have adopted it, and increasing interest in it is being evinced. The writer considers that it presents a solution, or partial solution, to several important problems of Rhodesian agriculture, and this aspect of the matter will be discussed later in this article.

SECTION I.—TECHNIQUE OF COMPOSTING.

A. Rain-watered Compost.—Detailed technique.

Materials Required.—(1) *Vegetable matter of any kind,* such as maize trash of all kinds, including the cores; dry or green grass; spoilt hay or silage; stalks of sunflowers, cotton and sunnhemp after threshing; wheat, barley, and oat straw and chaff; leaves of trees and scrub bush; saw-dust, waste paper, and rags in limited quantities; the top-growth of the sunnhemp crop. All green materials should be withered before use for a day or two.

(2) *Dung* of cattle, horses, sheep, goats, pigs and poultry.

(3) *Ordinary field soil*—top seven inches only. Where soil soaked in urine is obtainable this is to be preferred, since it contains much nitrogen. It can be collected from cattle kraals, collecting yards, cow byres, etc.

(4) *Wood ashes or agricultural lime.*—Wood ashes should be used for preference as they contain potash and phosphate as well as lime.

Proportions of Materials Required.—The above materials will be required in the following proportions—

Parts by volume.	Materials.	Parts by weight.
420	Mixed vegetable wastes, etc.	400
*36 to 18 or less.	Ordinary soil (urinated if available).	*56 to 28 or less.
24	Animal dung.	80
*3 to 6	Wood ashes.	*6 to 12
or 1 to 2	Agricultural lime.	*or* 2 to 4
or $\frac{1}{3}$ to $\frac{2}{3}$	Burnt lime.	*or* 1 to 2

*For explanation of variation of proportions see Section II. under "Varying Proportions of Ash and Soil."

To assist rapid rotting the mixed wastes should consist of at least 25 per cent. of wastes with a high nitrogen content, as specified in the list given in Section II.

Method.—A well drained site should be selected, with a reasonably smooth surface, to avoid water-logging and to make turning easy.

Making the Heaps.—Having assembled all the materials required, the mixed wastes should be made into a heap 16 feet broad and $1\frac{1}{2}$ feet high, and of any convenient length. The heap should be built up in *at least* two layers to ensure even mixing of all the materials at the first turn, as far as possible. *More and thinner layers will assist proper mixing of the materials.* A shallow heap such as this facilitates rapid wetting of the materials with the first rains, and therefore a quick start to the process of rotting, and also makes the first turn easier.

The soil, dung, and wood ashes or lime are spread evenly over the surface of each layer.

The materials should be collected during the dry season and the heaps should be ready and awaiting the first spring rains.

First Turn.—After the first heavy rains have partly wetted the heap, usually after about 2 to 3 inches of rain have fallen, the heap should be built up into a new heap 9 feet broad at the base by 3 to $3\frac{1}{2}$ feet in height, by throwing the materials with a fork in towards the centre line from either side. In doing this mix all the materials thoroughly. *The heap should be left in a loose open condition to assist aeration, and the easy entry of further rain. On no account should the heaps be packed by trampling at any time.*

Second Turn.—In three to four weeks, when the heaps have sunk and packed appreciably, they should be turned to one side or one end, and built up into new heaps of the same dimensions. If rotting has proceeded well, labour may be economised at this and subsequent turns by the use of a dam-scraper, or hay sweep, or similar ox-drawn implement. If rotting is unsatisfactory the use of sharpened "badzas" will help to ease the work.

Third Turn.—The heaps will require turning again in about a month as before, and will be rebuilt in their original position, and rotting should be complete in a further three weeks to one month. If rotting has not proceeded normally a further one or two turns may be necessary.

The various turnings are done to ensure aeration, and even distribution of moisture or materials, and they should usually be done on a rainy or cloudy day to check evaporation, unless the heaps are waterlogged. The compost is usually rotted down and ready for use in four months. If it is ready before the end of the rains it is best to delay spreading it on the fields for ploughing under until the seasonal rains have ended, so as to avoid loss, and it should be covered as soon as it is spread for the same reason.

On the other hand, if there is a special reason for using it as early as possible, and providing rotting has proceeded normally, the compost can be applied to the land at the third turn.

Sowing Sunnhemp on the Heaps.—When the wastes being composted are mainly of low nitrogen content, such as old dry grass and maize wastes, or if it is desirable to speed up the rotting process as far as possible, sunnhemp should be broadcast on the surface of the heap after the first turn. The writer has found that the common sunnhemp makes better growth under these conditions than the Somerset variety, and two or three pounds of seed per 100 square yards of surface may be used. It is not necessary to add a surface of soil to enable the sunnhemp to grow.

The sunnhemp will only grow some 6 to 12 inches high before the next turn, but the roots penetrate the heap and the bacteria in the nodules on the roots collect nitrogen from the air. When the sunnhemp is turned under at the next turn this nitrogen promotes rapid rotting, and enriches the compost.

In some cases the writer has seen the sunnhemp being allowed to grow to a height of two or three feet. This is a sign that turning has been unduly delayed, and that the proper heating in the heaps had ceased. It also makes the subsequent turning of the heap very difficult.

B. Artificially-watered, or Winter Compost.—When a supply of water is available compost can be made throughout our rainless winter. It should be made in shallow pits in order to protect it from the drying winds, and to help maintain the temperature in the heaps.

Size of Pits.

Depth—2 feet—never deeper.

Width—15 feet.

Length—any convenient; but a 60 to 65 feet long pit is suitable, and contains about 25 tons, or 50 cubic yards, of moist ripe compost. The sides and ends of the pits should be cut with a slope at an angle of 45 degrees.

Filling the Pits.—The same materials and the same proportions of them are required as for rain-watered compost. Fill these into the pits in shallow layers, say, 6 inches deep. The shallower the layers the better will all the materials be mixed at the first turn, and the more rapidly will rotting commence, and the more smoothly and evenly proceed.

Fill the pits to a height of 6 inches above ground level. Leave 8 feet at one end of the pit empty for turning.

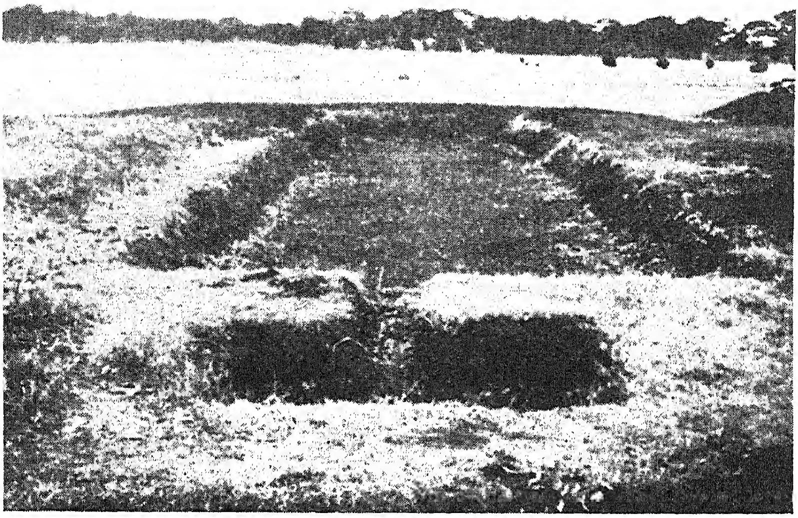
Watering.—Each layer may be watered as it is filled in. It should be well wetted, but not drowned in water.

Turning.—As soon as the pit is full, turn the materials, and shake them up, and mix them thoroughly. Sharpened badzas will be found useful at this stage. Turn from the end where the empty space has been left, and move the whole heap 8 feet, so that 8 feet of empty space is left again at the opposite end, for the next turn.

Second Turn.—Three weeks later, water the heap and turn again.

Third Turn.—A month later, water and turn again. If necessary a further turn should be given.

A month later empty the pits and stack the compost at the side in heaps 9 feet broad by 4 feet high, to mature for a further month. It can be carted to the fields and ploughed in at this stage if desired.



Type of pit for making winter or irrigated compost. Sump shown in foreground not necessary.

Winter compost being turned in pit in foreground. Heap of ripe compost beyond.

At each turn after the first the amount of water required is much less than before the first turn, and care should be taken not to use too much. The heap should be just moist all through, but not "sopping wet." Excess of water will prevent proper aeration, and rotting may stop in extreme cases.

If there is any urgent need to hasten the process, then the heap can be turned every 10 days or two weeks, and more dung added; or, if this is lacking, sulphate of ammonia may be used at the rate of $\frac{1}{2}$ lb. to 1 lb. per cubic yard of the heap, or bone-meal at the rate of 2-4 lbs. per cubic yard.

If the pits are watered from a water furrow, care should be taken that they are not near enough to the furrow to become water-logged by seepage from the furrow.

SECTION II.—EXPLANATORY.

The process of rotting. What is happening in the heap of compost.

In order to ensure that the composting shall be intelligently managed, and therefore proceed rapidly and economically, it is necessary to know something of what is happening in the heaps during decomposition.

The rotting of the waste materials is carried out chiefly by certain micro-organisms found in the soil. Of these certain fungi commence the process of breaking down the organic material, and the bacteria assist and complete the work. In a properly rotting heap after the first turn the temperature should rise rapidly to somewhere about 130° to 140° F. within a few days, and soon after this the materials should be greyish white in appearance due to the growth of the white fungus mycelium.

Both the fungi and bacteria require a proper supply of *water, air* and *nitrogen,* in order to carry on their work; also a sufficiently high temperature, and a neutral or slightly alkaline medium to work in.

Water.—Sufficient moisture, but not an excess, is required. An excess causes a drop in temperature owing to the slowing up of the process. If at any time the heap becomes water-logged owing to continuous heavy rains, turning it will remove the excess moisture, and assist aeration at the same

time. Excess of water tends to exclude air by packing the heap. If the heap becomes too dry, on the other hand, owing to a continuous drought, it may be spread out again into a heap 16 feet wide at any time, so as to ensure quick and ample wetting by the next rains; and then immediately after the rain it should be built up into a heap of the standard size of 3 to $3\frac{1}{2}$ feet high by 9 feet broad.

Air.—An ample air supply is absolutely necessary in order to supply the oxygen requirements of the micro-organisms. This is regulated by avoiding trampling the heaps when building and turning; by shaking up the materials thoroughly at each turn; by avoiding excess of moisture by giving extra turns during heavy continuous rains as already mentioned; and by avoiding the use of excessive quantities of soil.

Green wastes should be withered before composting, since in the green sappy state they tend to close up the air-spaces in the heap, and so reduce aeration. Proper aeration is necessary not only to ensure the proper progress of rotting, but because in the absence of it large losses of nitrogen may take place owing to the activities of other types of micro-organisms, which attack the nitrogen compounds, and break them down to free nitrogen gas.

Nitrogen.—The micro-organisms require a sufficient supply of nitrogen for building up into their body protein. Part of the organic or combined nitrogen (chiefly in the form of proteins) is given off as ammonia during the rotting process, but this is fixed by the soil, and by the lime in the wood ashes, or is converted into the nitrate form by other micro-organisms.

When the rotting process is finished the micro-organisms die, owing to lack of food, and the nitrogen in their cell or body tissue is converted by other bacteria in the soil into soluble nitrate nitrogen, which is directly available to plants.

Therefore during this process there is little or no danger of loss of nitrogen by leaching by the rains until the process of rotting is finished. In fact, when the process proceeds properly, and there is no excess of nitrogen in the materials, there are large gains of nitrogen made from the air, by nitrogen fixation by free-living bacteria, and by the agency of the root nodule bacteria of the sunnhemp grown on the heaps.

In the cattle kraal, however, there are always huge losses of nitrogen to the air in the form of gaseous nitrogen or ammonia, and by the leaching out of the urine, and nitrates by the rain.

Loss of nitrogen will, however, take place if the ripe compost is stored in heaps too long before use. However, this should seldom happen to any great extent in this Colony, since the process fits the seasons so admirably. The process commences with the rains, and should finish with the ending of the rainy season, and if the compost is then spread and ploughed under it is safely banked in the dry soil until the following crop is sown.

The proper supply of nitrogen is regulated by the proportions of dung and urinated soil added to the "mix" and by the proportions of the crop wastes of high or low nitrogen content which are employed. If the normal amount of dung is used then approximately 75 per cent. of the crop wastes may be of low-nitrogen content.

If no dung or other source of extra nitrogen is used then at least one-third of the wastes should be of high nitrogen content.

Below is a list giving the common farm wastes according to the rough classification used above.

High Nitrogen Wastes.	Low Nitrogen Wastes.
(1) *Young* green grass.	(1) Maize rubbish of all kinds.
(2) Soft green weeds.	(2) Old dry grass.
(3) Green sunnhemp, or other legumes.	(3) Spoilt hay and silage.
(4) Legume crop residues and spoilt legume hays.	(4) Stalks of sunflowers, cotton, and sunnhemp after harvesting.
	(5) Cereal straw and chaff.
	(6) Thatching grass.

The farmer will find the analyses of Rhodesian foodstuffs published as Departmental Bulletin No. 1035 of assistance. Any suitable material having a crude protein content of 10 per cent. or more can be placed in the category of high nitrogen wastes.

If excess of nitrogen is present in the compost heap the process will proceed more rapidly, but loss of nitrogen will take place in the form of ammonia or nitrates, and this is uneconomic. If there is a shortage of nitrogen in the mixture then the process may be slowed down so much that it will not be finished in one rainy season. It may assist the farmer to mix his wastes economically if it is mentioned that one part of green sunnhemp, not more than three months old, with three parts of wheat or barley straw without any other nitrogen supply, makes approximately a perfect mixture of materials for composting without adding any dung. Some soil, and wood ashes or lime, would also be required, of course.

Crop wastes may be composted in normal time without the use of any external source of nitrogen, either in the form of dung or any other material, providing the mixture of materials contains the proper proportion of nitrogen. The use of some animal dung is always advised, however, since there is an increasing body of evidence that, besides supplying nitrogen, and stimulating nitrogen-fixation, the use of animal dung leads to the ripe compost containing certain growth-promoting, or stimulating, substances, without which crops do not thrive so well, and are not so resistant to diseases and pests. Some of these have already been isolated and synthesised, and at least one is now marketed commercially for the purpose of stimulating the root-growth of cuttings.

Other Sources of Nitrogen.—One of the principal virtues of the Indore compost is that no materials except such as are present on any farm, on which oxen are used for traction, are necessary to make it.

Inorganic sources of nitrogen, such as sulphate of ammonia, nitrate of soda, cyanamide, nitrochalk, etc., have been recommended for composting low-nitrogen materials such as wheat straw, without the used of animal dung, by various writers in the local Press and elsewhere, recently, *but the writer strongly deprecates their use, save in exceptional circumstances, since thereby the cost per ton of compost is greatly increased, and this may render the process uneconomical.*

If inorganic sources of nitrogen alone are employed in composting, the cost of a 5 tons per acre dressing may rise to somewhere in the neighbourhood of £4 to £5, where only low-nitrogen material such as wheat straw are composted. The cost of making a 5 ton dressing of rain-watered compost, using only farm sources of nitrogen, should not exceed 10s., and should be appreciably lower under favourable conditions.

When organic, combined sources of nitrogen such as are found in animal dung, bone-meal, sunnhemp and other vegetable materials, are properly employed, there should be no loss of nitrogen up to the completion of the rotting process, but definite gains.

Ayyar* has shown, however, that rapidly available inorganic nitrogenous compounds such as those mentioned above are unsuited to climatic conditions similar to ours, since they cause too rapid a decomposition in the early stages, resulting in loss of nitrogen. In heaps in the open a loss of 26-40 per cent. of nitrogen was observed. The use of slowly available sources of nitrogen such as bone-meal and dung gave even rotting, and reduced the loss of nitrogen to 5 per cent.

Nevertheless, the householder who cannot employ animal dung, or the farmer or market gardener who, for some reason, finds it essential to speed up the composting process, may employ sulphate of ammonia, nitrochalk or cyanamide as their sources of nitrogen. The amount required will vary greatly according to the type of materials to be composted, but as a rough guide it may be mentioned that 68.2 lbs. of sulphate of ammonia are required to rapidly decompose a ton of a material such as wheat straw, or maize husks and stalks, which have a low nitrogen content in the neighbourhood of 0.5 per cent., or a crude protein content of about 3.0 per cent.

Where about one quarter of the mixed wastes are of relatively high nitrogen content one pound to two pounds of sulphate of ammonia per cubic yard of wastes should suffice. *The actual minimum amount required must be found by experience, and if the same mixture of materials is always used this is simplified.* If ammonia is given off freely during rotting then the supply of sulphate of ammonia has probably been

*Utilisation of Farm Wastes. Agric. Jour., Madras, Vol. 21, p. 335.

too generous, and must be cut down in future. If, on the other hand, too little sulphate of ammonia has been added then the rotting process will be unduly slowed down.

The same proportion of cyanamide as of sulphate of ammonia may be used. About 25 per cent. more nitrochalk must be employed, but since it contains 50 per cent. calcium carbonate, a parallel reduction in the amount of lime used may be made. Calcium cyanamide also contains lime, and in considerably greater proportion than in nitrochalk, since it contains a total calcium equivalent of 60 per cent. calcium oxide, or the equivalent of rather more than its own weight of calcium carbonate, or agricultural lime.

To yield about the same weight of nitrogen as 1 to 2 lbs. of sulphate of ammonia, $4\frac{1}{2}$ to 9 lbs. of bone-meal (4.4% N) are required, and these quantities will suffice for one cubic yard of wastes, of which about a quarter have a relatively high nitrogen content.

The use of bone-meal is recommended as an artificial source of nitrogen for composting, *where this is required,* and particularly where the phosphate content of the wastes, as in maize wastes and old dry veld grass, is known to be deficient, and where the price is about £6 per ton.

Other Requirements of Micro-organisms.—*Phosphates.*—The micro-organisms carrying out the rotting of crop wastes require a certain amount of phosphate to use for building up into their body tissue With a normal mixture of several types of crop wastes and residues, there will usually be sufficient phosphate for their use.

Where crop wastes such as maize wastes, and old dry veld grass or thatching grass alone, are being composted, there may well be a shortage of phosphates, and the addition of a small quantity of one of the cheap basic phosphates such as rock phosphate may be added with the soil and wood ash. Besides phosphates rock phosphate also contains bases, which are useful in maintaining the reaction of the compost heap near neutrality. The writer has used basic slag at the rate of 1 bag per 50 to 75 cubic yards of heap under such circumstances. Slag also contains bases, which are roughly equivalent in lime value to the same weight of agricultural lime. One bag of

slag can thus, besides supplying phosphate, replace an equal quantity of agricultural lime, or three bags of wood ashes, in the compost heap.

Where an external source of nitrogen is also required bone-meal may be used to supply phosphate, since it contains about 4 per cent. of nitrogen in addition to the phosphate, and also lime. Bone-meal contains bases, which are equivalent to about half its weight of agricultural lime.

Bases.—The micro-organisms work most vigorously in a medium which is between neutral and slightly alkaline.

To ensure these conditions basic material such as wood ash, agricultural lime, and burnt lime are added to the compost heap. The wood ash contains a varying proportion of lime according to the amount of leaching by rain it has undergone. The more it has been leached, the higher the proportion of the lime, since other materials such as the potash are lost. Wood ash in Rhodesia contains about 18 to 50 per cent. of lime (CaO). It also contains about 0.4 to 5 per cent. of potash, and the same percentage of phosphoric oxide.

The ordinary loam soils which are approximately neutral, also contain bases, which are useful in maintaining the right reaction of the compost. The ordinary sandy soils are apt to be rather acid in reaction, and the sandy vlei soils are usually very acid. Some of the heavy black vlei soils, on the other hand, may contain a very high proportion of lime, and these would be particularly valuable for use in compost, since they would supply all the lime necessary, as well as the clay, fungi and bacteria.

Varying Proportions of Ash and Soil.—In the tables of proportions of materials given above the proportions of soil, and of lime and wood ash, vary. The reason is that if the amount of soil added is reduced below the maximum, then the proportion of lime or wood ash should be increased in order to adjust the amounts of lime and other bases added to the heap. It is better to err on the side of adding rather more ashes or lime than is necessary, than to add too little.

The basic material, besides neutralising excessive acidity, is required for the purpose of temporarily absorbing the ammonia which is produced, and so preventing its loss.

Soil.—The soil added to the compost heap is required for the following reasons:—

(1) To supply bases such as lime to neutralise acidity and maintain the reaction of the process near neutrality, and for the temporary absorption of ammonia.

(2) To supply clay to form a colloidal film on the surface of the waste materials, which assists the fungi rapidly to commence their action; and also to assist in temporarily absorbing the ammonia.

(3) To supply the necessary fungi and bacteria.

Where the soil is known to be definitely acid, the proportion of wood ash or lime should be increased, and that of the soil reduced to the minimum found by trial to be necessary.

Sandy soils do not supply much clay or basic materials, and it is recommended that never more than 18 parts by volume to 420 parts of wastes should be used, and trials should be conducted with less and less to find the minimum proportion. More lime should be added where sandy soil is employed than where loam soil is used.

Dung Slurry can replace Clay of the Soil.—The lack of clay in sandy soils can be corrected by sprinkling a thin slurry of *fresh dung* stirred up in water. If this is sprinkled over the materials as the heap is being built, a thin film is formed over the surface of the materials, which replaces or reinforces the film normally formed by the clay of the soil. This serves to assist the fungi to commence their work easily and rapidly, by giving them a supply of moisture, and food materials handy for their immediate use.

In the same way when the proportion of loam soil is reduced to the minimum, the lack of clay may be made good by the use of dung slurry.

Use of Dung Slurry always worth while.—The use of the dung slurry when building compost heaps can always be recommended, since it is extremely effective in ensuring a quick start of the rotting, and also, more important still, even rotting throughout the heap.

The little extra trouble caused by using it is far outweighed by the big saving of labour obtained by reducing the quantity of soil in the mixture to the minimum. When the normal amount of soil recommended for the Indore process is used (36 parts by volume in the above table of proportions) the soil represents a large proportion of the finished compost, and a considerable proportion of the labour employed is required for the collection and spreading of the soil, and later in riding and carting the ripe compost.

Reducing the Soil Increases Humus Content.—It must be borne in mind that such a reduction in the proportion of soil used will be followed by a proportionate increase in the proportion of humus in the ripe compost, and therefore of its manurial value.

The rate of application per acre can therefore be reduced. As a rough guide it may be stated that if a reduction in the soil be made from 36 parts to 18 parts by volume in the mixture recommended in Section I., then a 5 to 6 tons per acre dressing will be roughly equivalent to an 8 tons dressing with the full 36 parts of soil. The economy made in the labour of carting and spreading the compost will be obvious from the above figures.

Excess of Soil.—The use of any excess of soil beyond the recommended maximum is very inadvisable, since not only will it have the disadvantages outlined above, but it will cause the heaps to pack more; and air will be excluded; and loss of nitrogen will take place by the action of anaerobic bacteria in breaking down the nitrogen compounds to the gaseous forms, ammonia and free nitrogen.

Use of Minimum Quantity of Soil.—For these reasons farmers are advised to reduce the proportion of soil, especially sandy soil, gradually until they find the minimum required, and replace the clay and basic material in it, by the use of the dung slurry, and increased amounts of ashes or lime.

To be economic it is essential that the cost of making compost shall be reduced as far as possible, and this is one way of doing this.

Cross-inoculation from Older Heaps.—Another means of speeding up rotting, and ensuring even rotting, is by inoculation of a heap at the first turn, by sprinkling a small quantity of the material from an actively rotting heap about 10 days old over the heap as it is turned. The material taken should be white with the fungous growth.

When making the dung slurry, this fungous material can be mixed with it, together with some of the wood ashes or lime, to make a thin slurry, which is then sprinkled lightly over the materials as they are turned. Only a very light sprinkling is required.

In the same way at the second turn, a small amount of compost from an actively rotting heap about 30 days old may be lightly sprinkled over the materials as they are turned. This inoculates the heap with active bacteria.

When starting compost making, small "pilot" heaps can be made and watered artificially to provide the requisite material for these inoculations. In making winter compost these cross inoculations are particularly valuable, since they can be carried on from one heap to another successively, and this is found to increase the virulence or activity of the strains of fungus and bacteria very greatly.

Cracking Hard Materials.—Hard materials such as whole maize stalks, cotton stalks, tobacco stems and roots, and sunflower stalks, are not easily attacked by the fungi, as they are protected by the hard woody "bark" or outer covering.

If these are included in the compost heap and it is desired to complete the rotting within the four months of the wet season, then they should be cracked or crushed, either by placing them in a cattle kraal for a week or two, or by placing them on a track or road freely used by farm traffic, or by running a heavy roller or culti-packer over them.

Where such materials form a large proportion of a compost heap there is a greater need to use dung slurry, and the full amount of soil, than for a normal mixture of materials.

Where sunnhemp is composted on the land it is strongly recommended that all such hard materials be mixed with the sunnhemp in the temporary kraals. This solves the problem very simply, and the time and cost of carting will be repaid by rapid rotting, and a reduction in the labour of turning the heaps at the first turn.

Combined Use of Compost and Phosphatic Fertilisers.—Compost made by the methods described contains only a small percentage of phosphate, and it should be used in conjunction with dressings of phosphatic fertilisers. In this way the best results of both the compost and the fertiliser will be obtained. Particularly in acid soils the humus of the compost is extremely valuable in tending to prevent the fixing or immobilising of the added phosphates by the soil in a form unavailable to crops, by their combination with aluminium or iron. Thus the humus increases the availability of the phosphates added to an acid soil. It is possible that a reduction in the normal rate of application of phosphatic fertilisers may be possible where compost is used, but each must test this carefully for himself.

Many farmers have asked the writer whether the separate spreading of the phosphatic fertilisers cannot be avoided by mixing the latter with the compost in the heaps. This can be done, of course, but if the farmer wishes to apply a definite amount of phosphatic fertiliser per acre, a carefully taken composite sample of the finished compost will have to be analysed, if he is to know just how much phosphate he is adding per acre.

The writer cannot recommend this method of applying the phosphates with the compost, since he is of the opinion that the farmer will have difficulty in regulating the exact application of the phosphatic fertilisers at the rates found most profitable by experience.

Compost and the Common Crop Diseases and Pests.—Since the compost is made from crop residues the question of whether diseases and pests can be carried over from year to year through the compost is one of some importance, particularly to the maize grower, who is composting maize residues, since the question of the control of the diplodia group of diseases is of some moment.

An enquiry was addressed on this matter to the Director of the Imperial Mycological Institute and his reply is given below:—

"Replying to your letter of the 20th March, I believe that there would be very slight, and probably no risk, of spreading the maize diseases caused by *Diplodia zeae* and *Gibberella saubinetii* by adopting the Indore method of composting the stalks, trash, and mouldy cobs, provided the material is suitably prepared and the method properly carried out. The optimum temperature for the germination of the spores of the mycelial growth of *Diplodia zeae* lies between 80° and 86° F. and the maximum between 95° and 104°; a temperature 10° higher than the maximum if maintained for a relatively short period under the conditions of aeration and humidity of the fermenting mass would destroy that fungus and other pathogenic fungi. In a normal fermentation the temperature during the first few weeks may rise to about 150° F. and be maintained near that for a considerable time; such a temperature under the moist conditions of the fermentation must be rapidly destructive to the pathogenic fungi."

It would appear, therefore, that where compost is properly made there is little or no risk of the spread of these diseases by its use. The same cannot be said of kraal manure, since high temperatures are not maintained throughout the manure for any time, and the possibility of danger in this regard must be borne in mind.

Tobacco Diseases.—Since it is known that some of the tobacco "spot" diseases will withstand the temperature of flue curing without being killed, it seems clear that there is danger in the use of the tobacco crop residues, such as primed leaf, old stalks and scrap, in compost which is to be applied direct to the tobacco crop.

If, however, the compost in which these materials are incorporated, are applied to the crop (other than tobacco) preceding tobacco, there should be no danger of fostering the various diseases of this crop by the use of compost, and there is evidence that the proper use of organic manure renders the tobacco crop more resistant to disease.

Compost made from other materials, excluding tobacco wastes, can be safely applied to tobacco.

Pests.—The common maize pests, such as the stalk borer and ear worm, will not be able to live in properly made compost.

Eel-worm, also, will not live through the composting process.

To sum up the position briefly, it is considered that the only danger of spreading plant pests and diseases by the use of properly made compost, is in the case of the tobacco crop as already mentioned.

SECTION III.

COMPOSTING THE SUNNHEMP GREEN-MANURE CROP.

There is undoubtedly a valuble place for Indore compost in Rhodesian agriculture as a means for eliminating the great waste of organic matter in the maize crop wastes, and the other crop residues which are burnt each year, and also in preventing the great waste of plant food which is being lost from the cattle kraals and feeding pens of the Colony, by the extensive leaching, and denitrification which take place.

However, the writer is convinced that there is a still greater field of usefulness for the modified technique of composting outlined below, which it is suggested should be applied to the sunnhemp green-manure crop.

It is necessary here to make it clear that at present the claims made for the system only apply to the sunnhemp crop, and to the heavier loam soils, and not to other green-manures or to the sandy soils. The evidence on which the system has been designed will first briefly be given.

Defects and Disadvantages of Green-manuring.—Although the practice of green-manuring has been of great value to Rhodesian agriculture, it suffers from the following serious defects and disadvantages:—

(1) A large proportion of a farmer's land is idle and unproductive each year under green-manure.

(2) The manurial value of the green-manure depends too much on factors outside the farmer's control, such as the rainfall following ploughing under, and preceding the planting of the maize crop. Results are variable and undependable.

(3) Much damage is done to the tilth of the heavy soils by the farmer being forced to plough under the crop when the soil is too moist, because he is working against the time factor.

(4) The top growth of the sunnhemp crop only gives a small additional yield from the following maize crop compared with that given by the stubble alone.

(5) Only a portion of the green-manure crop can be ploughed in under the optimum conditions of time, soil conditions, and weather, owing to the slowness of ploughing.

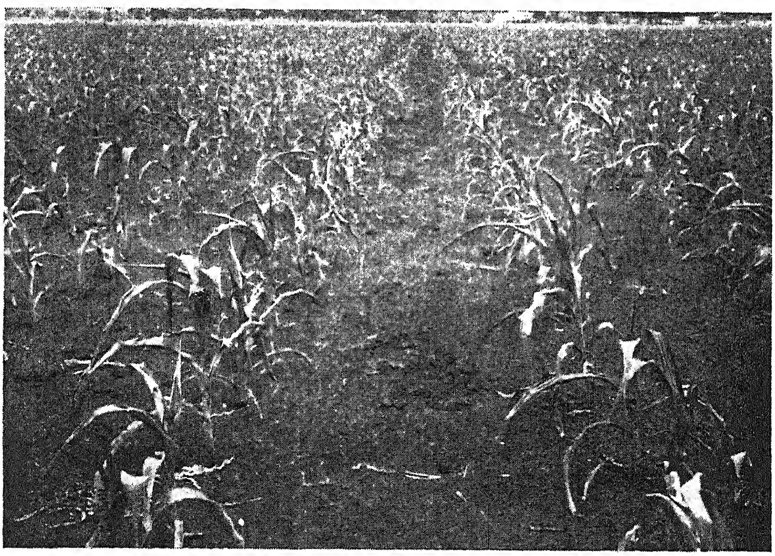
(6) A second ploughing is nearly always necessary, and this is very hard on the oxen, and costs money.

Ploughing in versus Reaping Sunnhemp.—In five different series of experiments carried out continuously over the past 11 years the increased yield of maize obtained by ploughing under the whole sunnhemp crop, as compared with ploughing under the stubble only, has been as follows:—1.10 bags per acre; 0.99 bag per acre; 1.94 bags; 0.91 bag; and 1.36 bags per acre. The average of these results is 1.26 bags per acre. This is borne out by the observations of experienced farmers, many of whom have informed the writer that they have been able to see no difference in the effect on the following maize crop of ploughing the whole sunnhemp crop in, and the effect of the stubble alone, where part of the crop has been reaped for seed or cut for hay.

Results from Composting Sunnhemp Tops.—Trials at the Agricultural Experiment Station, Salisbury, have shown that the top-growth of a poorly grown crop of sunnhemp, stunted by the drought of the 1935-36 season to a height of only 4 to 5 feet, when composted by the Indore process yielded 8 tons of moist compost per acre of top growth.

Another series of experiments has, in the first year's results, shown that the manurial value of the compost made

(1) Maize which received compost made from sunnhemp tops. Note drought resistance due to compost.



(2) Maize following sunnhemp burnt on the land. Note severe drought effect and compare with above photograph. Both plots planted same date, and photographed same date.

from the sunnhemp tops is of rather higher value, judged on the basis of the yield of the following maize crop, than the whole sunnhemp crop ploughed under, as shown below:—

Treatment.	Percentage increase in yield of maize over the controls reckoned as 100.
Compost made from sunnhemp tops	139.80
Whole sunnhemp crop ploughed under	135.13
Sunnhemp stubble, plus compost made from tops... ...	159.49

The 6 treatments (only 3 shown here) were replicated ten times on plots each 1/20 acre in size, in randomised blocks. A considerable loss of nitrogen from the compost was almost certainly caused by excessive watering of the heaps in the final stages of manufacture, owing to inexperience of the process, and it is now certain that the sunnhemp was cut too early to give the best results. It is very probable that if it had been cut three or four weeks later, from a normally well-grown crop, and the compost properly made, that the results would favour the compost still more.

Reducing the Area of Idle Land under Green-manure.—On the basis of the above facts the writer is of the opinion that the area of unproductive land under green-manure can be reduced by at least fifty per cent. and at a big profit to the farmer, by the composting of the sunnhemp tops, and he advises farmers to test the system for themselves on a moderate scale. A number are already doing so.

Gains and Losses.—Before describing the modified system of composting suggested, the potential profits and losses of the system as compared with ploughing under the whole sunnhemp crop may be estimated in the case of a farm in the maize belt with 600 acres under the plough, of which 200 acres are normally green-manured, in order to illustrate the potential benefits of the system.

Under the system suggested only 100 acres of sunnhemp would be grown each year, and the top-growth composted and applied to the other 100 acres which would normally be green-

manured. Of course, in the first year no compost is available, and the whole 200 acres should be under sunnhemp, and half or more of it would be composted.

Table of Potential Gains and Losses.

Losses.				Gains.			
(1) 126 bags of maize @ 8/3	£51	19	6	(4) 1,200 bags maize in 3rd year ... =	£495	0	0
(2) Cost of making compost @ 1/6 per ton, and 8 tons per acre, on 100 acres ... ... =	60	0	0	(5) Saving on 2nd ploughing of 200 acres @ 4/- ... =	40	0	0
(3) Complete fertiliser @ 200 lbs. per acre on 100 acres (14/- per acre) =	70	0	0	Total gains...	£535	0	0
				Total losses...	£181	19	6
Total losses	£181	19	6	Nett gains	£353	0	6

The items in the above table may be elaborated as follows:—

Item 1.—This is simply the loss of yield on the 100 acres of stubble due to removing the top-growth, at 1.26 bags per acre.

Item 2.—Compost has been made in Northern Rhodesia @ 2s. 9d. per ton when the materials were carted to the site and hand labour was used throughout. Under the system outlined below all carting is avoided, and most of the hand labour, and it is estimated that the cost of making compost will be not more than 1s. 6d. per ton, and probably less.

Item 3.—This is a dressing of 200 lbs. per acre of a complete fertiliser having an analysis of approximately 25.1% P_2O_5 (total), 4.1% nitrogen, and 3% potash. The cost per ton of the materials for mixing on the farm is £6 5s. 0d. approxi-

mately. Railage and spreading are reckoned at 15s. per ton. This fertiliser has been used with great success for several years by farmers in the Mazoe Valley and elsewhere.

Item 4.—The yield of maize in the third year, on the 100 acres which received compost in the first year, with 200 lbs. per acre of the above fertiliser, is estimated at 12 bags per acre. The average pay out per bag for the past two years is 8s. 3d.

Item 5.—On a sunnhemp stubble, or on a maize stubble, only one good ploughing is necessary, and thus the second ploughing necessary after ploughing in sunnhemp, which is so hard on the oxen, is avoided.

This table of losses and gains is merely intended to assist the farmer, who contemplates a change of system, to decide whether it may be worth his while or not, and it is only suggested that he should test the system on a moderate scale to start with until he has gained experience.

"Hidden" Gains.—Neither the extra cost of riding and spreading the compost, nor the costs of cultivation, reaping and marketing the extra 100 acres of maize are included. It is considered that these items may be more than balanced by the "hidden" gains which are to be expected, but are impossible to estimate accurately. For instance, the normal practice in the maize belt is to sow the sunnhemp crop in dry soil just before the rains. This means that much damage is done to the tilth of the heavy soils by ploughing it under whilst the soil is still moist during late February and early March, whereas in the system suggested the sunnhemp stubble should not be disturbed until the soil is dry.

Moreover, in a proportion of years heavy losses of maize may be caused, probably by leaching out of nitrogen by late rains in March and April, when green-manure crops are ploughed under in late February and early March. This is very well illustrated by the results of an experiment published in the October, 1937, issue of this Journal, where a sunnhemp

crop of approximately 14 weeks' growth in each case was ploughed under at fortnightly intervals from February 21st to April 21st, 1936. The results are tabulated below.

Sunnhemp crop (in each case 14 weeks old) ploughed under on:	Yield of following maize crop per acre in bags of 200 lbs.	Percentage increase in yield due to later date of ploughing under.
February 21st, 1936	14.22	100
March 7th, 1936 ...	15.36	108.08
March 21st, 1936...	16.75	117.78
April 6th, 1936 ...	17.56	123.41
April 21st, 1936 ...	17.75	124.89

The rainfall during March, 1936, was 5.44 inches, and during April, 1936, 0.56 inches of rain fell.

Since the sunnhemp crop was approximately the same age in each case at ploughing in, it is probable that the losses in yield of the following maize crop are due to the too early nitrification or rotting of the sunnhemp, and subsequent losses of plant foods due to leaching by rain. Some of this loss was no doubt caused by the first rains in November, 1937, before the young maize was able to take up the available nitrogen; certainly in the case of the sunnhemp ploughed in on the 6th and 21st of April, since only 0.30 inch of rain fell after the 31st March, and this fall was preceded by a dry period of several weeks and therefore probably had no leaching effect.

Losses by Leaching of Plant Foods Avoided.—Where the top-growth of a sunnhemp crop is removed for composting and the stubble left undisturbed until the cessation of the seasonal rains, these losses should be avoided, since the micro-organisms in the soil require not only moisture but the ample supply of air brought about by ploughing to enable them to convert the insoluble organic nitrogen, and other plant foods, in the sunnhemp stubble, into the soluble forms, which are subject to leaching by the rain.

In connection with the losses of nitrogen in the soluble nitrate form by leaching there is one point of great importance, which is usually lost sight of, and that is that nitrate does not pass out of the soil by itself. It must be in combination with some base. For instance, for every pound

of nitrate nitrogen leached, either .07 of a pound of calcium (the active principle of lime), or 0.8 of a pound of magnesium, or 2.8 pounds of potassium are also lost, or equivalent proportions of all three.

It is therefore clear that green-manuring in this Colony must lead to considerable losses of available lime and potash from our soils. These can be avoided by the composting of the top-growth, and early planting of the following crop so that the latter will be in a position to utilise the nitrates as they are formed in the soil, before they can be leached away.

Again, it often happens that the ploughing under of the sunnhemp crop is unduly delayed by heavy rains, so that much of it is too mature to exert the best effects on the following maize crop.

The writer has frequently seen large areas of sunnhemp being ploughed under when almost mature. In such cases unsatisfactory results on the following maize crop must occur owing to (*a*) nitrogen starvation of the young maize; (*b*) an excessively open seed bed causing the soil to dry out unduly during the dry spells, and making it difficult for the roots of the young maize plants to obtain their food supplies; (*c*) phosphate starvation of the young maize owing to its temporary immobilisation by the micro-organisms carrying out the rotting of the sunnhemp; possibly also (*d*) shortage of oxygen in the soil for the same reasons mentioned under (*c*); an inferior stand of maize due to unrotted material interfering with planting.

These ill-effects are obviously absent when a sunnhemp stubble is ploughed up after the seasonal rains have finished, as is clearly proved by the remarkable stimulation of the young maize, which has been always noted, under varying seasonal conditions since 1931 at the Salisbury Experiment Station, and also in the Mazoe Valley and elsewhere.

When ploughing under a large acreage of sunnhemp there must necessarily be many weeks difference in the time of ploughing under of the first and last ploughed portions of the crop, with the inevitable losses already mentioned, due to leaching of plant food or over maturity of the sunnhemp.

Some of the above losses can be partially avoided by later sowing of the sunnhemp, but this interferes seriously with farm organisation, and in any case green-manuring must remain a gamble on the weather conditions, since if later sowing is adopted the early cessation of the rains will entail a poor growth of sunnhemp.

Where the sunnhemp tops are composted, since the reaping will normally be done in dry weather and on dry soil, in the last week of March and in April, as mentioned below, all these difficulties are practically eliminated, and a much more dependable and regular manurial effect will be obtained over a period of years, than in the case of green-manuring.

SUGGESTED MODIFIED TECHNIQUE FOR COMPOSTING THE SUNNHEMP CROP.

The simple technique advised is given below followed by a more detailed explanation.

(1) Mow the sunnhemp at 18 to 20 weeks from germination.

(2) Sweep and drag it up to narrow moveable kraals on either side of the field along the headlands.

(3) Fork the sunnhemp into the kraals as fast as the cattle can keep it trampled down.

(4) When there is a depth of well trampled sunnhemp of 18 inches in the kraal, move the latter along the headlands and fill again.

(5) After moving a kraal, spread top soil from the field, and wood ashes or lime over the heap.

(6) Build the sunnhemp into heaps 9 feet broad by 3 feet high, by forking in towards the centre line from either side.

Time of Mowing.—It is recommended that the crop should be left to grow two to four weeks beyond the stage when ploughing is usually *begun*, which is about 14 weeks from germination. It is suggested that reaping should commence at 18 to 20 weeks from the date of germination. This will bring the commencement of the reaping to about the end of March, when the sunnhemp is germinated in the middle of November.

The work will therefore normally be done during April, when no more rain usually falls, and the surface soil is dry. This will facilitate the work and avoid damage to the tilth of the soil.

It is known that the woody tissue or lignin of the organic matter is the chief and most stable constituent of the humus formed by its rotting down, either in compost heaps or in the soil, and it follows that the higher the proportion of wood in the original material the greater will be the quantity of humus left after decay has ceased, and the longer will this humus and its effects last in the soil.

McChlery has shown that there is a steady increase in the fibre or woody portion of sunnhemp from 70 days from planting up to 139 days, or approximately 18 weeks, and this probably continues for several weeks more.

Therefore, by delaying cutting the sunnhemp until 18 weeks and onwards, the amount of humus produced by composting it and the persistence of its effects in the soil, will be materially increased. *It is considered that this will prove to be a very important advantage of this system of utilising the sunnhemp crop.*

It is not advisable, for various considerations as shown above, to plough under the sunnhemp at so late a stage of growth, but these objections do not apply to the composting of the crop by the technique advised here, as will be seen later.

Use of Moveable Cattle Kraals.—Having mown the sunnhemp, or as soon as a portion has been mown, easily moveable cattle kraals, of a width of 16 feet, and a convenient length, are erected on the headlands of the fields on either side.

The sunnhemp is then gathered by hay sweeps into cocks of a convenient size, and these cocks, several at a time, are drawn by hay drags up to the side of the kraals and dumped. From these dumps the sunnhemp is forked over the side of the kraals and spread over the floor until about 18 inches deep. Cattle are then placed in the kraals, and as fast as they can trample down the sunnhemp under foot it is daily forked over into the kraals.

When the sunnhemp has been trampled down to a depth of about 18 inches, and sufficiently broken up and impregnated with urine and dung, the kraal is then moved along the headland and the process repeated until the whole field of sunnhemp has been dealt with.

The types of implements suggested for this work are illustrated, and instructions for making two of them cheaply on the farm are given in the Appendix.

Subsequent Treatment of Sunnhemp.—As soon as a kraal has been moved, the heap of sunnhemp and dung may be treated thereafter as compost. Soil from the adjoining field is spread over the heap with a little wood ashes or lime, as advised above; half the required quantities being used. The heaps are then built up into the standard size of 9 feet broad by 3 to 3½ feet high, by forking in the sunnhemp from either side towards the centre line. Finally the remaining half of the soil and wood ashes or lime are spread over the surface of the heap, which is now left to await the next season's rains.

Hastening the Process for Dressing of Winter Crops such as Wheat.—If some of the compost is urgently required for winter crops the same year, the sunnhemp can be cut and composted a month or six weeks earlier when, if three turns are given at intervals of ten days to a fortnight (on rainy days if possible) the compost should be ready for applying to the land about two months later. It may be necessary, in order to ensure this, to increase the number of cattle in the kraal or the time they are kept in the kraal, so as to crush the sunnhemp stalks more thoroughly, and to increase the nitrogen and moisture content of the compost by increased quantities of dung and urine.

However, since the sunnhemp itself will have a high content of nitrogen and contain less woody tissue when cut at this stage of growth (12 to 14 weeks) the question of the rapidity with which it will rot will be largely dependent on the rainfall during March, the extent to which the sunnhemp is crushed by the oxen, and the frequency of turning the heaps.

It will be best, for this purpose, to leave the sunnhemp undisturbed after moving the kraal until a good shower has fallen, since the wide shallow heap will ensure much more rapid and thorough wetting of the heap by the rain.

Hastening the manufacture of the compost in this way is, of course, wasteful, since a reduced quantity of humus is obtained, and this humus will not last so long in the soil. It is also wasteful of the dung and urine.

Economy of Land on Small Farms.—On the smaller farms where economy of land is of particular importance, the composting of the green-manure crop will be of particular value, since only one-sixth or one-eighth of the land need then be idle under green-manure instead of a third or a quarter.

For the same reason, on small farms, at the first turn of the heap after moving the kraals, the inner half may be folded over on to the outer half. This will mean that a strip of land only 9 feet wide will be occupied by the compost heaps, but the amount of hand labour will, of course, be slightly increased.

Alternative System of Composting Sunnhemp.—An alternative system which could be employed is to keep the normal proportion of land under sunnhemp. In the example already considered two hundred out of six hundred acres would be composted, and the compost applied to another hundred acres of land. In this way two-thirds of the land, or in this case 400 acres out of 600 acres, would receive a dressing of organic manure each year—every acre growing crops, in fact.

By adopting this system the humus content of the soil could be more rapidly built up to the economic level, and a change over to the other system be made after, say, two or three years.

This system might be more sutiable for a farm which has been badly overworked and the soil denuded of humus. In such a case the sunnhemp would possibly require fertiliser to ensure a good crop. It is not considered, however, that this system would be so profitable for normal use as the other, owing to the larger proportion of unproductive land under sunnhemp each year. The writer, nevertheless, reserves the

right to change his mind on this point, since there is a possibility that the higher humus content of the soil, which should be maintained by this system might, by giving higher yields per acre, more than counter-balance the disadvantage of having a smaller area under crops each year.

Sunnhemp Compost or Kraal Manure for Vlei Wheat.—The writer has already urged the wheat farmers growing wheat on the sandy vleis of the Colony to grow sunnhemp on their dry lands during summer for conversion into compost, or kraal manure.

The simplicity, economy, and great value of this have been proved conclusively by one farmer in Matabeleland, as described in Departmental Bulletin No. 1005, and he has greatly extended his use of the system this year with remarkably good results, and it is hoped that he will shortly write an account of his experience for publication in this journal.

He has found that he can cut his sunnhemp and convert it into well rotted kraal manure of very high quality in time to apply to his wheat the same year.

Remarkable Results from Using Sunnhemp Manure.—It may interest other wheat farmers to know that the 14 acres of his wheat dressed with sunnhemp kraal manure in 1936 gave an average yield of 13 bags per acre.

The writer wishes, also, to point out here that he was previously in error in stating that this wheat also received a dressing of phosphate fertiliser. *It received no fertiliser at all.*

So simple, inexpensive, and effective is this system of manufacturing the vlei wheat-grower's chief need, namely, organic manure, that it is again strongly urged that wheat farmers, particularly on the sandy vlei lands of the Colony, should adopt it without delay and grow sunnhemp on their dry lands for turning into compost or manure.

The writer is at a loss to understand why this system has not already been widely adopted. The only objection to it so far raised by farmers, of which he is aware, is that sunnhemp will not grow on their dry lands without fertiliser. If this is true, then farmers are strongly advised to apply a dressing of 130 lbs. of rock phosphate and 20 lbs. of muriate of potash

per acre to the soil before sowing the sunnhemp. The cash price of this f.o.r. Salisbury is 9s. per acre. Only half the acreage of the wet land under wheat need be sown to sunnhemp (on the dry lands), since one acre of sunnhemp should yield at least 6 to 8 tons of manure, the effect of which should last for at least two years in wet vlei soil, since the soil conditions in these wet vleis lead to much slower destruction of humus than on dry well-drained soils, owing to the lower temperatures and the water-logged conditions.

If the sunnhemp is grown in the second year on the first year's stubble this, with the residue of fertiliser, will give a second good crop of sunnhemp.

Therefore the cost of the fertiliser f.o.r. Salisbury per acre of wheat to which the sunnhemp manure is applied would be a quarter of 9s. per acre per annum, or 2s. 3d.

The cost of the sunnhemp seed at 33 lbs. per acre (Somerset variety), if grown on the farm, should not exceed 1s. 6d. per acre of *wheat* grown.

For this outlay of 3s. 9d. per acre of wheat grown, plus the cost of carriage on the fertiliser to the farm, should give an increased yield of wheat of at least fifty per cent., and probably 100 per cent., or more. Therefore even where the average yield of wheat per acre is only 2 bags, a handsome profit is assured.

Sunflowers instead of Sunnhemp.—Sunflowers can be used instead of sunnhemp, but the latter is advised wherever possible. Sunflowers should be seeded at the rate of at least 45 lbs. per acre, and cut when the flowers are just out, or earlier if speed is essential.

SECTION IV.

The Mechanism of the Decay of Crop Residues in the Soil and in the Compost Heap and its Practical Applications.—The density of the micro-organic population of the soil is so great that the figures are almost beyond the mental grasp of the average person. For instance, during a period of high activity in a fertile soil one ounce of soil may contain 140,000,000,000 bacteria, besides the other types of micro-organisms, which

may amount to another 31,000,000. The weight of the above numbers of bacteria in the top six inches of an acre of soil would approximate to 3.75 tons.

Their numbers are constantly fluctuating, depending on the factors affecting their growth; that is the supply of air, moisture and food, the temperature of the soil, the acidity or otherwise of the soil, and the numbers present of their natural enemies which feed on them. (The amoebae in the case of bacteria.)

Their food supply consists of the plant and animal residues in the soil, and carbon dioxide and mineral salts, such as phosphates and nitrates.

In the compost heap it is certain types of these microbes, which are supplied chiefly by the added soil, which use the crop residues and dung as their food supply, and break the former down during the rotting process.

Plant residues consist chiefly of carbohydrate materials such as celluloses, hemicelluloses, and lignins. The celluloses and hemicelluloses make up the softer tissues of the cell walls of the plant, and the lignins are the chief constituent of the woody or fibrous tissues, and the hardened portion of the cell walls.

The celluloses, and a portion of the hemicelluloses, are easily and rapidly broken down by the fungi and bacteria, which use them as sources of energy and food. Some of the carbon is built up into their body tissues, and the remainder, the greater part, they respire as the gas carbon dioxide.

Microbes have no mouths by which they can feed and have to absorb their food in solution through their "skins." They therefore bring their insoluble food into a soluble form by means of digestive ferments which they excrete. These ferments readily attack the starch and celluloses, and some of the proteins in the plant residues; but the lignins or woody portions are very resistant.

The proteins, in which form the nitrogen in the crop residues chiefly exists, are broken down into simpler nitrogen compounds; part is built up again into the insoluble body protein of the micro-organisms, and part is converted into

ammonia. The micro-organisms themselves contain much nitrogen; the bacteria, for instance, contain ten per cent.; and whilst they are alive this nitrogen is temporarily unavailable to crops. When the micro-organisms die on the completion of the rotting, owing to lack of food, and the compost is ploughed into the soil, as soon as the soil becomes moistened other bacteria feed on them and convert the protein in their dead bodies into the soluble nitrate form of nitrogen, which is at once available to crops.

SOME PRACTICAL CONSIDERATIONS WHEN COMPOSTING THE SUNNHEMP CROP.

Modern Conception of Humus.—The modern conception of humus in its simplest form is that it is largely a combination of plant lignin, and proteins; the latter synthesised by the micro-organisms. It also contains some residual hemicelluloses from the plant materials, and some synthesised by the microbes. It is therefore clear that the greater the proportion of lignin (wood or fibre) in the original crop residues of the compost heap, the greater will be the weight of humus left when rotting is finished.

Another constituent of the humus is a proportion of the hemicelluloses; the celluloses having completely disappeared. These hemicelluloses are not so resistant to further change as the lignin portion of the humus.

Now humus is not a constant, imperishable substance, it is a stage in the decomposition of the organic matter (crop residues), and when compost is added to the soil the humus undergoes further more or less rapid disintegration, according to the conditions existing in the soil. Some types of lignin, too, are more resistant to further chemical or microbiological change than others. The destruction of humus is a very much slower process, of course, than that of its formation by the decay of organic matter.

It is clear therefore that the more mature is any plant material, such as sunnhemp, the greater is the proportion of lignin or wood and fibre in it, and therefore the greater is the proportion of humus left after composting it, and the longer should the effect of that humus last in the soil.

This is a matter of considerable importance to the farmer who is composting his sunnhemp instead of ploughing it in, since it means that the maturity of the crop when he reaps it will greatly affect both the quality and lasting power of the humus made from it.

Minimum Nitrogen Content Required by Micro-organisms.—The rapidity of the decomposition of such plant materials in the compost heap is largely regulated by the percentage of nitrogen it contains, or which is added in the form of dung or urine. If the percentage of nitrogen in the plant material such as sunnhemp is less than 1.7 per cent. of the dry matter, the organisms which decompose it must have an added supply of nitrogen in the form of dung or urine to ensure rapid decomposition. A shortage of nitrogen will slow down the process, though it will still be completed, even though the original materials contain only a small percentage of nitrogen. The reason for this being possible is that the microbes commencing the process cease work and die when the nitrogen supply is exhausted owing to lack of food. Other bacteria then use the nitrogen in their dead tissues as a food supply to enable them to break down more of the carbohydrate material. They in turn die owing to shortage of nitrogen, and other bacteria use the nitrogen in their dead bodies and so on, until all the organic matter has been rotted down.

The nitrogen percentage in any crop falls as the crop matures, and it is therefore evident that the more mature the sunnhemp is at reaping time, when it is composted, the longer will the cattle have to be kept on to supply the deficiency of nitrogen by their dung and urine.

The farmer can only find this out by experience, but if he commences reaping the sunnhemp at 18 to 20 weeks from germination he will not have to keep the cattle on the sunnhemp for an undue length of time.

McChlery found that sunnhemp at 18 weeks from maturity may contain 1.50 to 1.90 per cent of nitrogen, according to the season in which it was grown; in one case a deficiency, in the other an excess, for rapid decomposition. In one year, 1933-34, it contained 1.5 per cent. of nitrogen at 20 weeks from germination.

In composting the sunnhemp crop by the method suggested above, another factor to be considered in deciding on the length of time to keep the cattle on the sunnhemp in the kraals, is the time it takes the cattle to crush the stubble sufficiently.

This question affects not only the rate of decomposition, but also the ease of the subsequent handling of the materials as compost, when turning the heaps. A little experience will soon provide the farmer with this information. It is also important from the point of view of speeding up the rotting process, since the crushing of the stems assists the fungi and bacteria to make entry rapidly, and exposes a far greater area of surface of the materials for them to work on.

For the reasons outlined above it will be found that unbroken stalks of sunflower and maize are very slow to break down in the compost heap, and it is advised that such materials should be placed under cattle to be crushed before being put into the compost heap, or better still, mixed with the sunnhemp where this is being composted on the land instead of being turned under.

SECTION V.

THE PLACE OF COMPOST IN RHODESIAN AGRICULTURE.

Until the middle of last century farmyard manure was practically the only fertiliser employed in Western agriculture.

During the last century Liebig announced his theory that the mineral constituents of plants supplied all that was necessary for their growth. Later the historic work of Lawes and Gilbert at Rothamsted showed that Liebig's view was only partly true, but at the same time it greatly stimulated the use of artificial inorganic fertilisers to such an extent that the benefits to be obtained from them, and the necessity for the use of organic manures to maintain the humus supply in the soil, came to be in danger of being lost to sight.

Latterly, however, the increase in our knowledge of the functions and properties of humus in the soil, due to the great extension of research directed on this subject, has caused the pendulum of agricultural opinion to swing in the other direction.

The rapid depletion of the organic matter in the soils of the large sub-tropical and tropical areas brought under cultivation by the white races during the last century, and the disastrous effects of this on the physical condition and therefore on the fertility of the soils, has helped to focus the attention of agriculturists and scientists on the great necessity for the proper and regular replenishment of the supply of humus in the soil.

Under the extensive system of agriculture largely adopted in these tropical and sub-tropical areas such as this Colony, the balance of nature has been upset, that is the balance between the natural supply to the soil of humus-forming organic material such as the leaves and root systems of trees and grasses, and its consumption or dissipation by the micro-organic population of the soil. The cultivation of the soil has slowed down the former and greatly speeded up the latter. The rate of consumption of humus in the sub-tropical soils by the micro-organisms concerned is very much greater than in temperate climates owing to the much higher temperatures favouring their activity.

It has been shown by Mohr that above an average temperature of 77.2° F. no accumulation of humus can take place in a well-drained and well-aerated soil. During our summer the soil temperature often exceeds 77° F. in the greater part of the cultivated areas.

This is the explanation of the much more rapid loss of humus from our soils, when under cultivation, than takes place under the temperate conditions of Europe.

The extensive system of agriculture still employed in the Colony has greatly limited the quantity of farm manure made. The use of this, and short and long term pastures, are the chief means employed in European agriculture to maintain the humus supply of the soil, but their employment in this Colony is only possible to a very liimted extent, at present.

This urgent problem has been met in a measure by the practice of green-manuring, which fortunately fits our climatic conditions well, owing to the almost complete absence of rain

during the period between cropping seasons, which tends to prevent losses of plant food from the green crop after it is ploughed in.

However, green-manuring in Rhodesia suffers from a number of inherent disadvantages as pointed out earlier, and there is a limit to the possibilities of its employment, as already mentioned in detail. The writer is of the opinion that many of these disadvantages can be overcome by composting the top-growth of the green-manure crop, where this is sunnhemp.

The supply of organic manure can also be greatly increased by turning all the residues from the maize, wheat and barley and other crops into compost. Their conversion into kraal manure should be discontinued in favour of composting, since the former process is very wasteful, and also insanitary, both from the point of view of crops and human beings.

It may be mentioned here that compost made from crop residues, chiefly maize wastes, has given remarkable results when applied to the cotton crop in this Colony. *Peat found at Gatooma that an application of five tons (short) per acre of compost gave an increase in the yield of seed cotton of nearly 100 per cent. over the untreated cotton. The untreated cotton yielded 500 lbs. per acre of seed cotton, whilst the cotton receiving 5 tons per acre of compost yielded 900 lbs. of seed cotton per acre. It seems probable, from the facts published, that one important reason for such striking results being obtained is that the compost materially aided the cotton to resist the effects of the serious drought of five weeks during February and March. Such droughts are always to be expected in this Colony, and the drought resistance which humus in the form of compost can confer on crops when applied to the soil is one of the weightiest arguments for its greater employment in our agriculture.

The amount of compost which can be made is limited by the supply of raw materials, and of animal dung. Besides crop residues, however, there is much raw material not yet

*J. E. Peat. Notes from the Cotton Station, Gatooma, 1937. *Rho. Agric. Jour.*, Oct., 1937.

utilised in the shape of old veld grass, reeds from the river-sides and streams. Also, there is a great quantity of grass cut on the sides of roads each year and wasted. The small awkwardly-shaped valleys in the hills could profitably be planted to a permanent crop such as Napier fodder to increase the supply of organic material and at the same time serve as fodder reserves.

Sunnhemp the Main Source of Cheap Raw Material.—However, the main source of cheap raw material at present is the top-growth of the sunnhemp crop, and the composting of this on the lines suggested, simplifies and cheapens the production of compost, by eliminating most of the expense of collection and carting of the raw materials, and most of the hand-labour.

It is perhaps pertinent here, in order to gain some idea of the very great possibilities of the system to estimate its potential advantages to the farming industry as a whole, on the basis of the total area of land annually under green-manure at present.

This is approximately 50,000 acres, and so at least 25,000 acres of this could be released to produce crops each year, which on the basis of the estimates given above should amount to 300,000 bags of maize, if this were the crop planted.

The estimate is based on the supposition, of course, that the whole area is normally sown with sunnhemp and that it is loam soil. This is not so, of course, but it serves to illustrate the possible gain to the farming industry by a change to the system suggested.

APPENDIX.

Labour-saving Implements for Composting.—A description of two types of hay sweep, and a hay drag, which will simplify and cheapen the collection of raw materials for composting, particularly when the sunnhemp crop is composted, are given below.

The Hosier Hay Sweep.—This implement was invented by Mr. A. J. Hosier, the pioneer of the open air milking system, and is being increasingly used by farmers in Great Britain, where it has been most successful.

The writer introduced this implement to the notice of Mr. A. S. Laurie, of Concession, who immediately appreciated its possibitlies, imported one, and with his usual public spirit arranged a demonstration of its working on his farm Somerset. Unfortunately very few farmers took advantage of this opportunity to see it in action, but it clearly proved its suitability to Rhodesian conditions.

On an earlier occasion Mr. Laurie kindly gave a demonstration to the writer of its ability to sweep up a crop of sunnhemp hay, which was lying in windrows, and the accompanying photographs show it in action on this occasion. The sweep was attached to an old Ford half-ton lorry and it moved over the uneven ground and along the sides of contour ridges without difficulty and swept the sunnhemp into large loading dumps at a remarkable speed.

The writer was greatly impressed with the work done by this implement, and he can strongly recommend it for use on ordinary farm fields in this Colony in sweeping grass and sunnhemp for composting or, of course, for hay.

With regard to its capacity Mr. Laurie writes as follows: "As regards work done: In three and a half days of easy going the sweep easily cleaned up 60 acres of land. Ten boys were building stacks and simply could not keep pace with it, and so it had to stand still much of the time."

"I am very pleased with the work done by the sweep (much of it on rough going); it saved endless time and labour, and my anxieties regarding sufficient winter fodder for livestock in future are a thing of the past, *and I should think for making compost it will prove just the very thing for collecting the material where and when required. No more ploughing under of sunnhemp in future, I am thinking.*"

The sweep is made in the following sizes and prices in England. The manufacturers are Messrs. Hosier Inventions, Ltd., Wexcombe, Marlborough, Wilts.

7 tines	(6 feet wide) for light cars	price	£5	15	0
9 tines	(8 feet wide) for 16 h.p. cars... ...	price	£6	10	0
11 tines	(10 feet wide) for cars over 16 h.p.,	price	£7	10	0

The handling and forwarding charges from Beira to Concession amounted to £1 3s. 0d. Spare tines cost 5s. 6d. each.

Mr. Laurie's sweep is a 9 tine model, but he thinks that possibly a 7 tine model might be more economical under local conditions, since it would probably allow the car to be driven on a higher gear.

Not only should this sweep go far to solve the problem of economically collecting the sunnhemp crop for composting, but it should enable farmers to make better quality veld hay owing to earlier cutting being made possible when the grass has a higher feeding value, owing to the fact that advantage can be taken of short dry spells during the months of January and February.

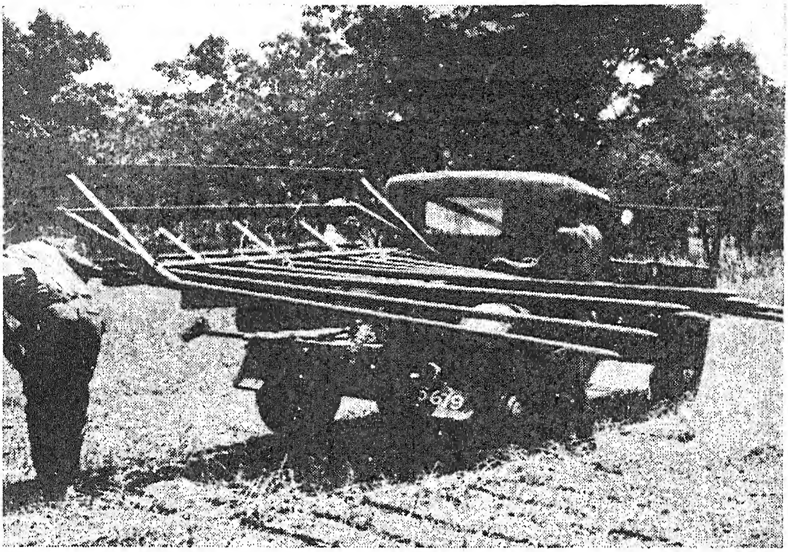
A Home-made Ox-drawn Hay Sweep.—This type of hay sweep was illustrated in the *Farmers' Weekly* of 17th February, 1937, and the instructions for making it were given by Mr. C. J. Littleton and are quoted below. This gentleman states that it is commonly used in Scotland and Northern England, where it is called a "Tumbling Paddy." Mr. A. Stidolph, farming near Salisbury, has had one of these sweeps made locally, and has found it of the greatest assistance in his hay making this year.

With two oxen and four natives it collected 36 acres of a good crop of veld hay into cocks in two and a half days.

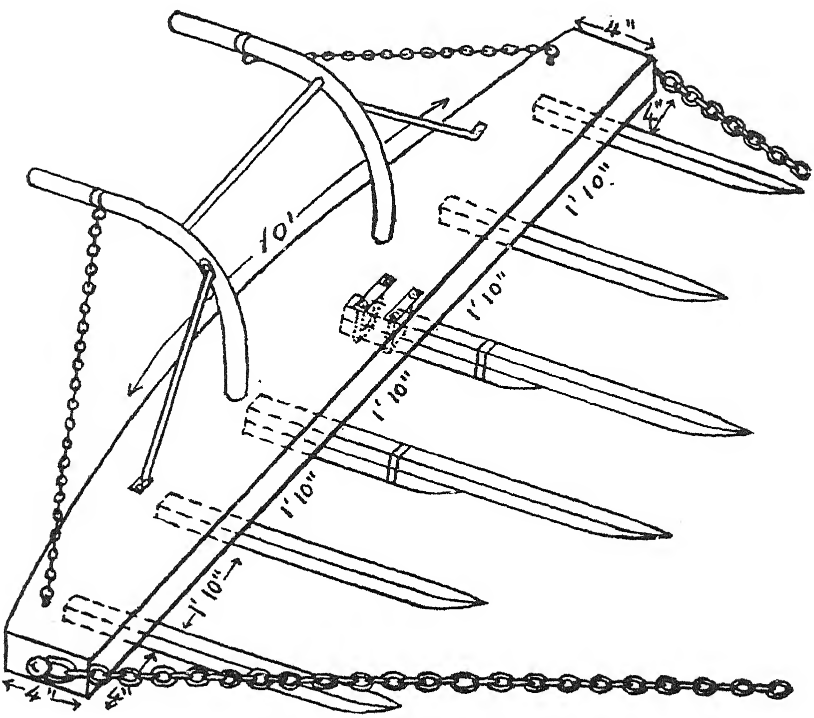
Since this sweep can be made on any farm it may appeal to many farmers, and Mr. Littleton's instructions for making it are as follows. (See illustration.)

"It is made of a stout plank 10 feet or 12 feet long and 9 inches wide in the centre, tapering to 4 inches at each end, with 6 wooden teeth; the two centre ones 4 ft. 6 ins. and the outside ones 3 feet long. These are pointed and shaped as shown, so as to keep them from running into the ground. There are two handles of a half moon shape with a light chain from each handle to the end of the plank to steady the load when full.

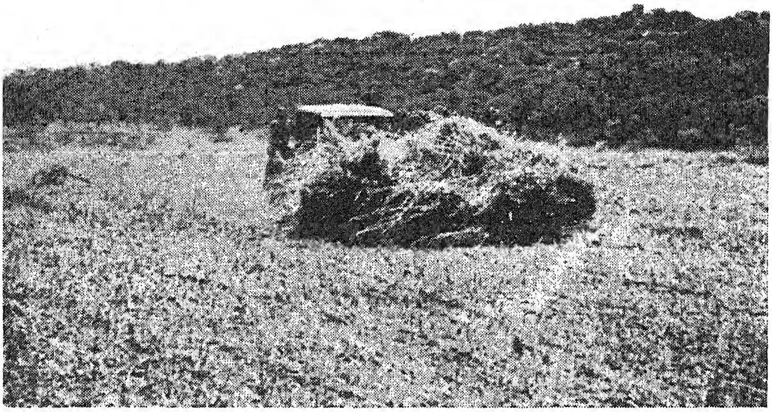
The draught is from the ends where the light chains are attached, swivel fashion, and brought to a point where the trek chain is hooked on. The chains must be fairly long to allow for the hay banking up on the sweep, and to allow the latter to turn head over heels when emptying the load.



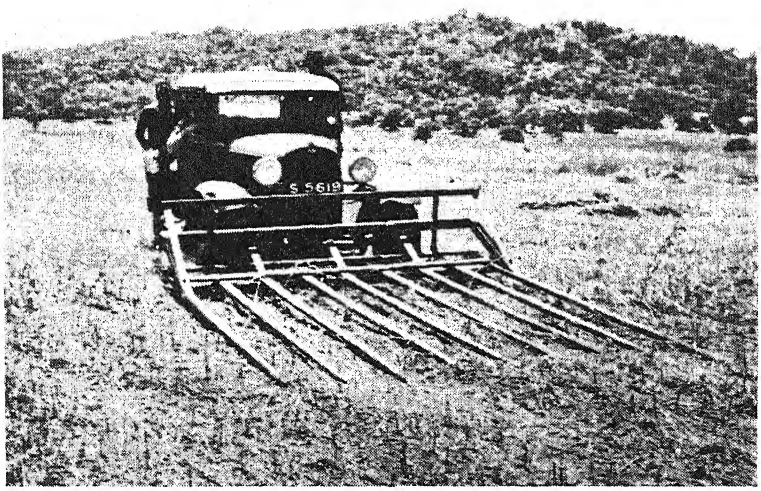
(1) The Sweep is easily removed in a few minutes for transport to another field. Note shape of points, which are metal-covered.



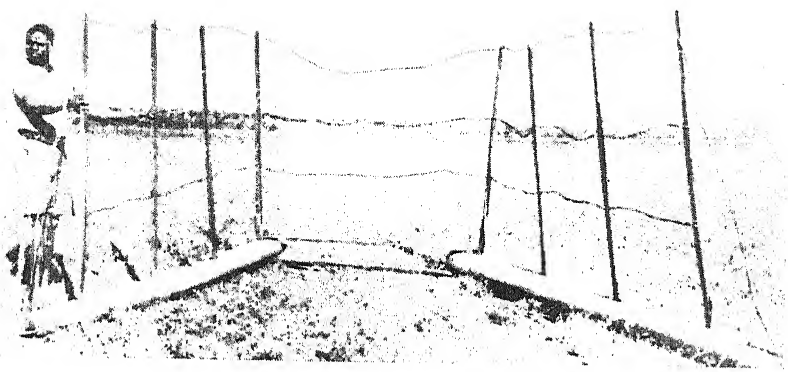
(2) Home-made Hay Sweep. (From "Farmers' Weekly.")



(3) The Hosier Hay Sweep in action on Mr. A. S. Laurie's farm at Concession. A full load of sunnhemp being pushed to the loading point.



(4) The Hosier Hay Sweep. It is attached to the dumb iron of the lorry.



Hay Drag for collecting cocks of sunnhemp.

The teeth are fastened to the plank, as indicated, by means of U-bolts. The two centre teeth are provided with short runners underneath to take the wear, such a sweep will hold approximately half a ton of hay.

To empty the load the team is stopped and backed and the sweep is pulled back about three feet, the handles are then lifted up to stick the teeth in the ground, and the oxen are driven on, and the sweep turns over dropping its load."

A Hay Drag.—A simple, inexpensive, but efficient hay drag as illustrated and described in the following notes was found extremely useful at the Gwebi Government Farm when the veld hay was stacked in the same field where it was cut.

The hay was cocked in the field, and three or four of these cocks were then collected by the hay drag and drawn to the stack-side, where a derrick fitted with scissor pincers lifted the hay up on tó the stack. This method of handling the hay saved a great deal of the labour and time normally employed in loading the hay on to wagons and pitching it from the wagons to the stack, and it will serve the same purposes in composting sunnhemp.

The drag consists of two wooden poles 6 to 8 inches in diameter, hinged at the rear by $\frac{3}{4}$ inch bolts to two parallel iron bars 3 feet by $\frac{3}{4}$ inch thick, and about 2 inches wide. The iron bars are bolted one above the ends of the poles and one below, the bolts passing through the iron bars and the poles. In four holes, evenly spaced along each of the poles, fencing standards of angle iron are fixed by wooden wedges. The implement is completed by three strands of barbed wire running through the holes in the fencing standards. The topmost wire of the three is carried down to the front end of each pole, and so serves as a stay wire to take the strain when a load is being moved. At the draught end of each pole an iron loop is bolted, to which the trek chains are fastened. A span of four oxen is hitched on to each beam; a leader is required for each span and one driver for the two, and an extra boy behind the drag. The latter is required to assist in guiding the drag on to the hay cocks; clearing it of hay at the stack-side; and in steadying the drag when reversing.

When picking up a load, the two teams of oxen are driven up to a hay cock and pass on either side of it, so that the latter is enclosed by the arms of the drag. When a full load has been collected it is drawn up to the stack-side and the two teams then reverse outward to either side; the drag turns inside out and the hay is released. At this point the extra boy is required to remove the hay which clings to the sides of the drag and to steady the drag as it reverses. The drag then goes off for another load.

A number of these drags are doing useful work throughout the Colony.

USEFUL FIGURES.

(1) One cubic yard contains 27 cubic feet.

(2) Two cubic yards of ripe compost weigh approximately one ton. Each two yards length of a heap of ripe, moist compost of the standard dimensions, 9 feet wide by 3 feet high, will therefore contain approximately 3 tons of compost.

(3) One sack has a capacity of approximately $4\frac{3}{4}$ cubic feet.

(4) Approximately $5\frac{3}{4}$ sacks of ripe moist compost weigh half a ton.

(5) One cubic foot contains approximately $6\frac{1}{4}$ gallons. Therefore $1\frac{1}{2}$ petrol tins contain rather less than one cubic foot.

(6) One acre inch of rain is equivalent to 101.1 long tons of water or 22,650 gallons (approx.).

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Southern Rhodesia Weather Bureau.

SEPTEMBER, 1937.

Pressure.—Mean barometric pressure was slightly below normal.

Temperature.—Mean temperature was below normal in the south and east and about normal elsewhere.

The weather during September was very changeable. During the first five days the centre of a low moved slowly up the East Coast and through the Mozambique Channel. Weather was fine and warm until the 4th, when temperatures fell considerably in the south with the arrival of a southerly high. The cool air spread to the north on the 5th. Cool weather, cloudy at first, continued until the 10th, when a low lay over the south coast. On the 11th a low formed over the west of South Africa, with a trough extending through to the coast. Temperatures rose rapidly and continued high until the 14th, when a high arrived in the south, bringing a short spell of cool weather. After this it again became warm, but on the 20th a further high brought cold cloudy weather with some drizzle to the south and east. The cool air did not affect the north until the night of the 21st. Cloud cleared fairly rapidly, but weather remained cool to cold until the 25th. Warm weather then prevailed until the end of the month.

PRECIPITATION.

Station.	Inches.	Normal.	No. of days.
Angus Ranch	0.09	0.16	2
Beitbridge...	0.24	0.15	1
Bindura	0.00	0.12	—
Bulawayo	0.00	0.17	—
Chipinga	0.59	0.76	7
Enkeldoorn	0.03	0.14	1

Fort Victoria...	0.00	0.20	—
Gwaai	0.00	0.12	—
Gwanda	0.17	0.14	2
Gwelo	0.00	0.17	—
Hartley...	0.00	0.10	—
Inyanga	0.04	0.21	1
Marandellas	0.00	0.26	—
Miami	0.04	0.02	1
Mount Darwin	0.00	0.07	—
Mount Nuza	0.55	0.90	7
Mtoko	0.00	0.03	—
New Year's Gift...	0.11	0.25	4
Nuanetsi...	0.31	0.17	2
Plumtree	0.01	0.03	1
Que Que	0.00	0.07	—
Rusape	0.00	0.17	—
Salisbury	0.00	0.26	—
Shabani	0.04	0.28	2
Sinoia	0.00	0.19	—
Sipolilo	0.00	0.11	—
Stapleford...	0.61	0.82	6
Umtali...	0.10	0.38	2
Victoria Falls	0.00	0.01	—
Wankie	0.00	0.03	—

SEPTEMBER, 1937

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	Wet Bulb.	Dew Point	Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute: Maximum : Date	Minimum : Date	Number of Days: Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
us Ranch... ...	...	65.9	57.7	52	8.7	82.0	56.9	69.5	97 : 13th	47 : 6th	12	2	1	...	...	...	...	...	...	...
bridge...	1,500	67.6	58.1	51	10.2	83.8	57.8	70.8	101 : 12th	44 : 6th	11	2	3	...	70.8	967.1	884.1	...	3.6	...
lura...	3,700	68.1	57.9	50	10.9	83.0	57.0	70.0	93 : 19th	49 : 2nd	12	1	...	...	70.0	893.8	883.6	...	1.6	...
ıwayo	4,393	63.9	52.8	42	10.9	81.0	53.0	67.0	91 : 13th	42 : 25th	11	4	...	...	66.2	871.2	882.7	869.3	2.7	9.6
›inga	3,685	65.0	56.2	50	9.2	75.3	53.9	64.6	91 : 13th	45 : 8th	6	9	...	...	63.5	894.6	883.9	...	3.8	...
eldoorn...	4,788	64.6	54.3	46	10.4	78.8	52.2	65.5	90 : 19th	40 : 25th	7	6	...	...	64.7	859.3	883.0	...	1.7	...
Victoria	3,571	66.0	55.4	47	11.0	79.7	52.4	66.1	93 : 13th	37 : 25th	11	7	...	1	66.0	897.9	883.6	...	3.6	...
ai Siding	3,278	66.4	55.1	45	11.7	89.7	51.3	70.5	99 : 16th	36 : 25th	22	...	1	2	...	907.2	883.5	...	1.5	...
nda...	3,233	65.2	55.1	46	10.2	80.6	54.5	67.5	96 : 13th	41 : 6th	11	5	3	...	67.3	908.5	883.2	...	2.8	...
lo	4,629	64.3	53.9	44	10.4	79.2	52.7	65.9	89 : 28th	36 : 25th	6	6	...	1	65.1	864.0	882.8	...	2.8	...
ley...	3,879	68.9	56.3	46	14.3	84.8	54.6	69.7	94 : 19th	44 : 25th	15	...	1	...	69.7	887.4	882.9	...	1.3	...
nga...	5,503	65.4	54.1	45	11.4	76.6	50.0	63.3	84 : 13th	39 : 25th	...	5	...	1	62.1	...	...	...	1.0	...
ındellas	5,453	63.2	53.2	44	9.8	76.1	52.3	64.2	86 : 19th	43 : 1st	1	6	...	...	63.8	...	...	...	1.0	...
ni	4,090	68.1	56.7	47	12.0	81.8	55.9	68.9	91 : 19th	46 : 1st	10	...	...	..	68.9	880.3	882.4	...	1.5	...
nt Darwin ...	3,179	70.3	59.1	51	12.5	84.9	56.5	70.7	96 : 19th	47 : 2nd	14	1	...	...	71.1	909.7	...	...	2.0	...
nt Nuza	6,668	56.4	49.8	43	5.8	64.2	48.2	56.2	76 : 4th	37 : 7th	...	22	...	2	55.1	803.3	883.0	802.3	3.6	...
ro	4,141	67.5	56.7	48	11.3	78.5	56.4	67.5	87 : 19th	48 : 1st	1	1	...	...	67.3	879.6	883.3	...	0.5	..
Year's Gift...	2,690	66.0	59.0	54	7.5	81.5	54.2	67.9	96 : 13th	45 : 2nd	12	5	...	...	...	...	...	...	...	7.1
ıetsi	1,581	67.2	59.0	53	8.6	83.1	54.2	68.7	100 : 12th	39 : 6th	14	3	2	1	...	965.1	884.6	...	4.3	...
ıtree	4,549	66.2	52.8	39	13.4	80.3	55.3	67.8	89 : 13th	44 : 5th	8	3	1	...	67.0	866.2	882.5	...	1.5	...
Que	3,999	65.9	54.9	45	11.2	83.9	54.7	69.3	92 : 19th	46 : 1st	14	1	...	..	69.1	883.4	882.6	...	1.7	...
pe	4,648	63.7	54.1	46	9.4	77.6	50.3	63.9	88 : 19th	37 : 25th	6	6	...	1	63 7	.		...	2.5	...
bury	4,831	66.1	54.7	45	11.7	79.9	53.9	66.9	87 : 20th	43 : 25th	5	1	...	...	66.3	857.9	882.6	856.3	1.0	9.8
ani...	3,131	66.3	56.1	47	10.8	80.9	55.2	68.1	95 : 13th	43 : 6th	11	5	1	...	68.0	...	...	...	3.9	...
a	3,795	69.8	57.1	47	13.7	85.7	52.5	69.1	94 : 19th	43 : 1st	18	...	...	...	67.3	890.0	882.9	...	1.0	...
ilo	3,876	71.3	58.6	49	14.0	82.1	57.7	69.9	91 : 19th	47 : 3rd	9	...	3	...	...	886.8	882.6	...	0.5	...
eford	5,304	60.5	53.8	48	6.4	69.5	44.4	56.9	81 : 4th	32 : 25th	...	12	...	7	57.0	844.1	883.4	...	2.8	...
ali...	3,672	66.1	57.1	50	10.4	79.5	54.4	66.9	91 : 13th	46 : 25th	11	4	...	...	65.9	895.1	884.2	893.5	3.0	...
ıria Falls... ...	3,009	70.3	56.1	44	15.3	92.9	56.1	74.5	101 : 13th	44 : 2nd	26	...	2	...	...	913.0	881.7	...	0.8	...
ɛie	2,567	73.5	57.9	45	17.8	93.2	64.1	78.7	100 : 19th	54 : 2nd	28	...	11	...	78.9	928.0	881.8	...	0.8	...

Southern Rhodesia Veterinary Report.

AUGUST, 1937.

DISEASES.

African Coast fever was diagnosed on the Chipinga Townlands and the farms The Nest and Umzelswe in the Melsetter Native district.

There was a slight extension of foot and mouth disease on Devuli Ranch, in the Bikita Native district.

TUBERCULIN TEST.

Eight bulls, sixty-one cows and fifteen heifers were tested upon importation. One cow reacted and was destroyed.

MALLEIN TEST.

Eighty-eight horses, one mule and eight donkeys were tested. No reactions.

IMPORTATIONS.

From the Union of South Africa.—Horses 55, mules 1, donkeys 8, bulls 5, cows 61, heifers 15, sheep 1,606.

From the United Kingdom.—Horses 2.

EXPORTATIONS.

To the Union of South Africa.—Oxen 616, cows 8.

To Northern Rhodesia.—Oxen 264, pigs 2.

To Nyasaland.—Horses 15, bulls 8.

To Portuguese East Africa.—Bulls 6, cows 10.

EXPORTATIONS—MISCELLANEOUS.

To United Kingdom in Cold Storage.—Chilled beef quarters, 9,637; frozen boned beef quarters, 7,864; frozen beef quarters, 5,673; chilled pork, 248 carcases; kidneys, 2,536 lbs.; tongues, 13,152 lbs.; livers, 23,831 lbs.; hearts, 8,865 lbs.; tails, 3,547 lbs,; skirts, 2,229 lbs.; shanks, 15,435 lbs.

Meat Products.—From Liebig's Factory.—Corned beef, 125,556 lbs.; meat extract, 23,272 lbs.; beef powder, 34,147 lbs.; beef fat, 23,000 lbs.; tongues, 5,400 lbs.; bone meal, 6,000 lbs.

B. A. Myhill,
Acting Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-37.

Monthly Report No. 58. September, 1937.

The month of September, as was the case last year, has shown a decided increase in the activity of the Red Locust (*Nomadacris septemfasciata*, Serv.) and swarms have been reported from most parts of the Colony. The majority of these swarms have been described as "large," and in two instances the swarm was reported as "enormous," one of these taking eight hours to pass over a single point, flying with a following wind.

The direction of flight has included most points of the compass and no particular trend has been apparent, but the Colony has gradually been penetrated from the N.E. and also apparently from the west.

Slight damage to growing wheat was reported in one district.

RUPERT W. JACK,
Chief Entomologist.

THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.
(Assisted by the Staff of the Agricultural Department).

PUBLISHED MONTHLY.

Subscription: 5/- per annum; payable to the Accountant, Department of Agriculture, Salisbury.

VOL. XXXIV.] DECEMBER, 1937. [No. 12

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Study of Mauritius Grasses.—A very interesting bulletin has recently been published by the Mauritius Department of Agriculture dealing with the mineral content of Mauritius pastures. The analyses of the common grasses—many of which are the same as ours—show that the mineral composition of the pastures in Mauritius is almost identical with that in Southern Rhodesia and that the conclusions reached apply equally well here. The conclusions are as follows:—

(*a*) Compared with a British cultivated pasture, the pastures in Mauritius are all more or less deficient in minerals.

(*b*) The elements most deficient are nitrogen and potassium; the average amount of phosphorus is low, but is nothing

like as low as the figures found in phosphorus-deficient areas of South Africa, on which malnutrition due to phosphorus deficiency has occurred.

However, when considering the value of a pasture one must bear in mind the statements of Orr: "When animals of an improved type bred on a mineral-rich pasture are transferred to a district with poor pastures, the low mineral content of the poor pastures is liable to be insufficient to support the rate of growth." Again: "It is commonly found that when high grade bulls are imported to grade up native cattle the mortality increases with the grading up, *i.e.*, as the rate of growth of the cattle increases," because "attempts have been made to improve the breed without ensuring that the feed was sufficient to maintain an improved breed."

(*c*) In conclusion, it may be said that in Mauritius there will be no improvement of cattle without an adequate improvement of pastures.

The Importation of Seed Wheat.—Until some five years ago the wheat crop of Southern Rhodesia had remained free from serious diseases other than rust. Within the last five years, however, loose smut of wheat has been introduced somewhat widely due, it is believed, to indiscriminate importation by farmers of wheat utilised for seed, from sources outside the Colony.

The continued importation of uncertified seed also involves the further danger of introducing noxious weeds which do not at present occur in the Colony. Many hundreds of different varieties and strains of wheat have been introduced by the Department of Agriculture during the last 25 years from all parts of the world and have been carefully tested to ascertain their suitability to local conditions of soil and climate, before being released for further trial by farmers. New introductions are still being made and tested out each year against the best of the established varieties.

It is considered that this system best serves the interests of wheat growers, since by its means unobserved spread of

diseases and noxious weeds is to a large extent prevented, while new varieties receive a proper and effective trial of their qualities and suitability to Rhodesian soils and climatic conditions. In this way too individual farmers are saved considerable expenditure—such expense being aggravated when the hitherto untried variety introduced by an individual farmer proves entirely unsuited to local conditions, and therefore fails to to produce a satisfactory yield.

In consequence it has been decided that permits to import seed wheat into the Colony will only be issued when, in the opinion of the Department of Agriculture, the proposed introduction will be of advantage to wheat growers as a whole or the milling industry. Where permits to import are approved certificates will be required to accompany the wheat, signed by the competent local authority (usually an official of the Department of Agriculture of the country of origin) to the effect that the wheat, which it is proposed to import, is free from disease and the seeds of noxious weeds. It will further be necessary for the applicant to satisfy the Department that the proposed importation is likely to be of advantage to the wheat industry of the Colony as a whole.

Water Bailiff Wanted.—Applications for the position of Water Bailiff at the Umgusa Irrigation Settlement are invited from persons having a sound knowledge of irrigation farming practice, and who desire to take up one of the holdings in the Settlement.

The duties will consist of regulating the distribution of water to the various participants under the scheme and the keeping of records of the amount of water supplied to each participant.

In return for these services the Bailiff will be allowed Plot No. 15, comprising 120 acres approximately, free of rental, the free use of 25 acre-feet of water per annum for irrigation purposes on this holding, and the free occupation of the homestead and other buildings on the plot.

In addition the Bailiff will be expected to perform the duties of Hydrographic Observer at the Umgusa Dam, for which he will be paid a salary of £2 per mensem.

Intending applicants should inspect the holding.

Applications should be addressed to the Secretary, Department of Agriculture and Lands, P.O. Box 387, Salisbury, to reach him not later than the 13th December, 1937.

New Motor Road to World's View.—A new motor road has been constructed on the Rhodes Matopo Estate which will permit motor vehicles to approach appreciably nearer to the "World's View" than hitherto, and which will be opened to the public as from the 1st December, 1937.

The new road leaves the present circular-drive route round the "World's View" a few yards on the Bulawayo side of the turn-off for the present short approach to the "World's View." The new turn-off has been suitably sign-posted.

Parking space has been provided at the terminus of the newly constructed motor road on an open space near "Pilgrim's Path" and at a point out of sight from the summit of the hill.

Further particulars of this new motor route may be obtained from the Secretary, Automobile Association of Rhodesia, P.O. Box 244, Bulawayo, from the Civil Commissioner, Bulawayo, or from the Senior Animal Husbandry Officer, Rhodes Matopo Estate, Private Bag 19K, Bulawayo.

Rothamsted Report, 1936.—The annual report of the Rothamsted Experimental Station fills a special place in the literature of science applied to agriculture. It reaches research workers in soil science and plant nutrition all over the world, and is of special interest to scientific workers, advisory officers and students in this country. It outlines the present position of the various investigations on soil and fertiliser problems conducted at the Station, and gives in full the yield figures

for 1936 obtained from some 120 experiments carried out at Rothamsted, Woburn and numerous commercial farms in various parts of England.

An important section summarises the results obtained in experiments on soil cultivation during the last eleven years. Contrary to the widely accepted view the results obtained up to the present indicate that under the conditions prevailing at Rothamsted, yields are not greatly dependent on the particular cultivation methods used, so long as the work is done at the right time. These trials must be continued but the figures already available are worth careful study. A preliminary discussion of the effects of fallowing on the yields of wheat on Broadbalk Field brings out the striking difference of behaviour between the starved and the fully manured plots. When the yield is poor, fallowing produces a large increase in yield; in the presence of nitrogenous manures the effect is much less and may even be harmful in the first year following. The benefit due to fallow appears to be only of one year duration as measured in the wheat crop. Experiments on the incorporation of raw straw with an accompanying dose of artificials show that handled in this way straw has so far produced much the same effect as dung or Adco compost. Other sections of importance deal with experiments on dried poultry manure and the effect of fertilisers on sugar beet.

Long period surveys of the work of certain departments have been a feature of recent reports. This year the summaries deal with Field Experiments, Fermentation, Insecticides, and Entomology.

The report is obtainable from the Secretary, Rothamsted Experiment Station, Harpenden, England, at 2s. 9d. post free.

Umgusa Irrigation Scheme.

Sub-divisions H and J of the "Helenvale" Block, now falling under the Umgusa Irrigation Scheme, have been sub-divided for European occupation into holdings of 167 to 247 acres, each holding having land suitable for, and capable of, irrigation. Each grantee will be entitled to 25 acre feet of water for winter irrigation, sufficient to irrigate about 10 acres of land. A permanent water rate of £22 10s. 0d. per annum will be charged in respect of each holding. If available, each grantee may obtain further water on payment of 10s. per acre foot for summer or winter irrigation.

Should, for any unavoidable cause, water not be available, the water rate will be reduced proportionately, but in that event the Government will not be liable for compensation.

The holdings will be granted, in the first instance, under lease for three years, at the expiration of which time the lease may be renewed for a further five years with the option of later acquiring the land under Agreement of Purchase terms. All rental paid will be credited to the purchase price if title is ultimately acquired. The first three years' lease will be regarded as a probationary period. Extension of the provisional lease will only be granted provided occupation and development of the holding has been carried our satisfactorily. Preference will be given to persons who have been resident in the Colony for an appreciable period, and who undertake not to engage in any other occupation than farming.

Title will not be issued until the land has been beneficially occupied and developed for a period of twelve years, unless the Minister considers that special circumstances warrant the issue of title at an earlier date.

Grantees will be carefully selected. Rental, plus the water rate, is payable half annually in advance. If any occupier is three months in arrear in meeting his water rate the water supply will be discontinued, and if he continues to be in arrear in payment of either water rate, lease rent or

instalments, the lease or Agreement of Purchase may be cancelled at the discretion of the Minister and the land be resumed by the Crown.

The price of the holdings varies from 30s. per acre to 35s. per acre, the rental being based on 4 per cent. of the purchase price. All irrigation and farmnig operations will require to be approved by the Minister. Soil conservation works must be undertaken and the land must be farmed in a husbandry-like manner. Over-stocking will not be permitted. Permanent improvements to the value of at least £250, as approved by the Minister, must be effected during the first three years of the lease. If a grantee relinquishes his land compensation may be paid, at the discretion of the Government, for improvements the nature and value of which have first been approved by the Minister.

Personal occupation by the grantee will be required and no grantee may sub-let or dispose of his holding or any portion thereof within a period of twelve years without the consent of the Minister, and then only if title has been granted.

A Water Bailiff will be stationed on the estate for the necessary adminstration and allotment of the water.

Further information can be obtained from the Under Secretary, Department of Lands, P.O. Box 373, Salisbury.

WHEAT.

BRIEF CHARACTERISTICS OF VARIETIES TESTED AT THE PLANT BREEDING STATION, SALISBURY, AND AVAILABLE FOR DISTRIBUTION.

By T. K. Sansom, B.Sc., Plant Breeder.

The following selected pure lines of wheats grown at the Plant Breeding Station, Salisbury, are available for free distribution to farmers.

Applicants are requested to apply early, stating what varieties are required. Not more than 10 lbs. of seed of any one variety of wheat, and not more than six varieties can be supplied to each applicant—

1. Reward B.21-22. S.1.
2. Reward B. 23-25. S.1.
3. Granadero.
4. Renown.
5. Pusa 4.
6. Sel. ex Riverina.
7. Karachi L.3.
8. Florence.
9. B.286.
10. Supreme.
11. B.256. b.1.A. 64.L.
12. N.B.230. A.14 (L.).
13. 122.D.I.T.L.
14. 131. C.5.P.
15. 58F.L.1.
16. Sabanero.

The two *Reward* strains have been grown on a fairly extensive scale during the past few years. They are beardless; of good milling quality; fairly resistant to rust; early maturing; but require a soil in good heart to yield well.

Granadero.—Is a bearded wheat, which is resistant to rust; it takes approximately the same time to mature as does Karachi.

Renown.—Is a beardless wheat; resistant to rust; early maturing; of good milling quality and fairly hardy.

Pusa 4.—Has been grown previously in this country; is beardless; it is susceptible to rust, but in those areas where rust is not bad will yield well; is early maturing and makes a little leaf growth, and therefore should be of use to those farmers who thresh by means of hand power.

Selection ex Riverina.—Is a beardless wheat, and should yield well in those areas where rust is not bad; is early maturing.

*Karachi L.*3.—Is a red seeded selection from Karachi; is bearded; susceptible to rust; and takes the same time to mature as does Karachi.

Florence.—Is a beardless wheat; fairly resistant to rust, and early maturing. It has shown promise at the Plant Breeding Station.

*B.*286.—Has been grown previously in this country; is a beardless wheat. Fairly resistant to rust and early maturing.

Supreme.—Is a beardless wheat; susceptible to rust; and late maturing. It is a tall growing wheat, and will yield heavily when rust attack is mild.

*B.*256. *bl.A.*64(*L.*).—Is a beardless wheat; resistant to rust and fairly early maturing. This wheat has shown promise at the Plant Breeding Station and elsewhere.

*N.B.*230.*A.*14.*L.*—Is a beardless wheat; resistant to rust and fairly early maturing. This wheat has shown promise at the Plant Breeding Station and elsewhere.

122.*D.*1.*T.L.*—Is a beardless wheat; resistant to rust and fairly early maturing.

131.*C.*5.*P.*—Is a bearded wheat; resistant to rust, and late maturing.

58.*F.L.*1.—Is a beardless wheat; resistant to rust, and late maturing.

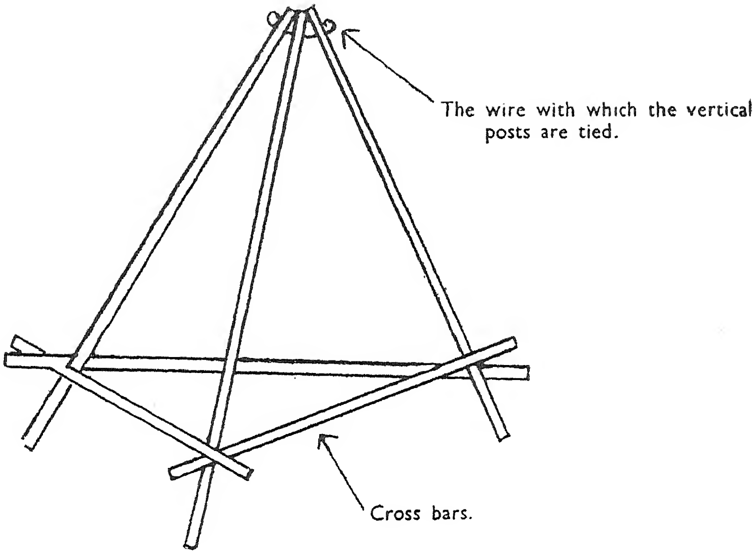
Sabanero.—Is a bearded wheat; resistant to rust, late maturing and tall growing.

The following varieties from the Umvuma wheat variety trials are also available for distribution:—

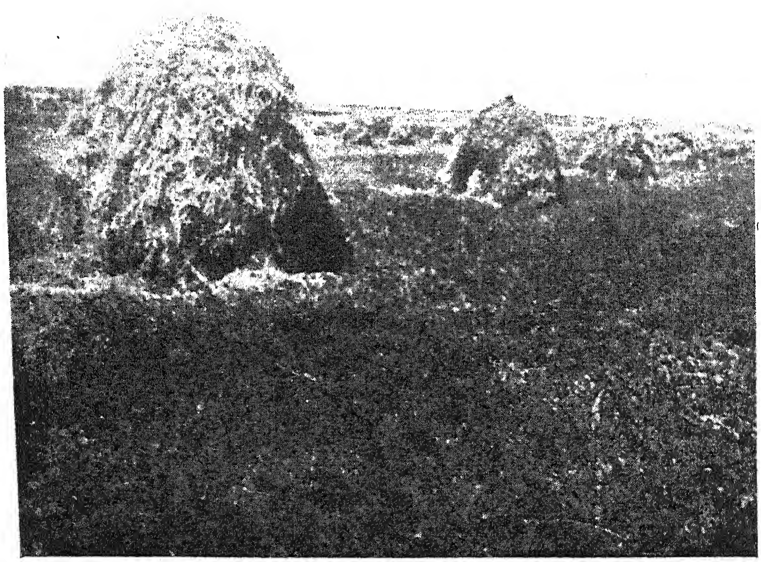
1. Punjab 8a.
2. Kenya Governor.
3. Quality.
4. Lal kasar wali.
5. F.6.W.1.O.

These are not pure lines, and may therefore contain small quantities of other varieties.

Applications should be addressed to the Agriculturist, Department of Agriculture, P.O. Box 387, Salisbury.



The tripod set up in position, prior to packing with hay.



Lucerne heaps packed on tripods.

Hay-Making during Unfavourable Weather.

By J. E. Pons, Extension Officer, Lydenburg.

Since the importance of accumulating fodder reserves during favourable seasons against times of scarcity has already been sufficiently stressed in the public Press and various agricultural publications, it will be unnecessary to dilate further on the matter here.

During protracted spells of wet weather, such as those which prevailed during the past season, great difficulty is often experienced in making good hay from crops such as lucerne and cowpeas. This difficulty can, however, to a large extent be overcome by the simple means of tripods or "ruiterstokken," as they are called in the Netherlands.

Constructing the Tripod.—This is a very simple device and is made of six spars, 6 to 7 feet long and about 2 inches in diameter. Three of these spars or poles form the uprights and are tied together at the top with galvanised wire, as shown in the accompanying photo. A $\frac{1}{4}$-inch hole is bored through each upright about an inch or two from the top and the wire is passed through these holes and knotted at both ends to prevent the poles from slipping loose. The wire thus serves as a sort of axle on which the poles can swing.

Each of the three uprights, fastened in this fashion, is also provided with a galvanised wire loop, about $2\frac{1}{2}$ inches in diameter, through which the other loose spars can be slipped. The loop is made on the side of the pole at a height of about 18 inches.

It is important that the wire, tying the poles together and forming the loops, be No. 6 galvanised wire. If thin wire is used, it would bend, causing the tripod to be pulled out of shape and rendering its erection or folding up for removal difficult in course of time.

In setting up the appliance the tied uprights are placed on the ground in the form of a tripod. The other three loose spars are then used as cross-pieces and placed from one upright to another about 18 inches from the ground. One end of the cross-spar is passed through the loop on one upright, and the other end rests on the end of the cross-piece (similarly placed) next to it.

The spars must be straight and can be cut from black wattle or gum trees on the farm.

The Tripods in Use.—The crop to be converted into hay should, after being cut, be allowed to become thoroughly wilted before being raked into windrows. The partially dried hay is then packed in small heaps on the tripods set up as above. When dried out sufficiently in these small heaps, the hay is packed into a big stack or stored in a shed.

Advantages of the Method.—By using the tripod method the hay can be stacked in small heaps earlier than is usually done. If rain threatens before the hay is dry enough to go into the ordinary type of heap, it can be packed on the tripod without any danger of its becoming heated. As the small stacks are open in the centre and the hay does not rest fully on the ground, there is a free passage of air through the hay, which can thus dry properly and retain its attractive green colour.

In view also of the hay being able to be stacked earlier than is usually the case, the leaves, which form the most valuable part of any legume hay, are better preserved. The use of tripods consequently ensures the production of a better quality and more nutritive hay, as well as its retention of an attractive green colour.

Since the hay rests on the cross-pieces of the tripod and not on the ground, the rain-water can pass freely under the heap without damaging any of the hay, except small whisps which may be overhanging and touching the ground. A further advantage of the tripod method is that, the heap being pyramidically shaped, the rain-water runs off quickly.

When these heaps are properly made, they can be left on the land for a considerable time without damage to the hay. On the outside the hay naturally becomes bleached, while inside the stack, it remains of a fine green colour.

Should much rain therefore fall after the hay has been packed in heaps or if waterlogged conditions prevent the passage of wagons over the lands, the farmer need have no anxiety as to the condition of his hay so long as the heaps are packed on tripods. In such case considerable loss might be sustained if the heaps were made without tripods.

Other Uses.—The tripods could further be used, especially during rainy weather, for drying and ripening beans, peas or similar crops which have been pulled up or cut for seed, and also for stacking crops such as buckwheat (which ripens unevenly) and cowpeas, of which the stalks take a long time to dry out. It will be found that many unripe buckwheat seeds will still ripen on the tripod.

These tripods are cheap, easily made, easily set up and shifted. A number of them will be a valuable asset on the farm, especially in areas where the rainfall is high and where great difficulty is experienced in making good hay.—*Farming in South Africa.*

Cement-Sawdust Stall Floors.

By Wm. L. Teutsch.

For more than twenty years the cement-sawdust floor in the barn of Hugh Wilson, Wallowa County dairyman, has given excellent service, and there is practically no evidence of wear. This barn floor, which was installed in 1916, has proved durable, warmer than cement, easier on the cows' feet, and yet permits all the sanitation of a cement floor, according to Mr. Wilson. In discussing the merits of the cement-sawdust floor for dairy barns, Mr. Wilson recently said, "If I were to build a thousand dairy barns I would have nothing but stall floors from a cement-sawdust mix."

The Wallowa Valley of Oregon has an elevation of about 4,000 feet, with long winters and relatively cold temperatures. It was in search of a warm barn floor and yet one that would permit sanitation that Mr. Wilson hit upon the use of a cement-sawdust mix. So far as known he is the first dairyman in Oregon to have tried such a floor and after 20 years he is more enthusiastic than ever before about its merits.

"My carpenter thought I was crazy to suggest such an idea," Mr. Wilson recently told me. "He consented to build the forms for the floor reluctantly. I was fairly sure of my ground, however, as I made a $1\frac{1}{2}$ inch slab of the mix to test its strength prior to actually pouring the floor. This gave me confidence in the idea. These floors have been used constantly for 20 years now and I can detect no wear yet."

Out of Mr. Wilson's experience and that of several other Oregon dairymen who have installed similar barn floors, has come the recommendation that when laying this cement-sawdust mix, a minimum amount of trowelling should be done to prevent concentration of cement on the surface. Mr. Wilson used only a rough board in floating his floor and the result was a floor less slippery than cement. Excessive trowelling causes the floor to be very slick and smooth and is impractical for a dairy barn.

The Oregon Experiment Station has found that a mix of this nature transmits about one-half as much heat as the same thickness or ordinary concrete or cement. Oregon dairymen who have used these floors testify that they are warmer. S. B. Hall, Holstein breeder of Multnomah County, says that in placing one's hand upon it, it warms up quickly and does not retain the cool, chilly feeling as does a cement floor.

The mix which Mr. Wilson used contained nine parts of sawdust, which he obtained from a nearby mill, and seven parts of cement. This mix he applied as a cover $1\frac{1}{2}$ inches thick on a concrete base.

As a result of research carried on by the Oregon State College it was found that cement-sawdust mix developed a compressive strength of from 1,500 to 1,700 lbs. per square inch in 28 days. The mixture carrying this strength was made up as follows:—

1 sack of cement, $1\frac{1}{2}$ cubic feet clean sawdust free from bark, $\frac{1}{4}$ cubic foot clean sand. Enough water to permit of easy placing.

The amount of water necessary will depend upon the moisture in the sawdust. The actual amount required will be from four to five gallons per sack of cement or even considerably less if the sawdust is very wet.

The best method for mixing is to mix well the sawdust, sand, and cement in the order named and then to add the water a little at a time with continued mixing until the mortar is of about the same consistency as the concrete used in the base. It will help both in securing better workability and slightly in the insulating qualities if about one quart in volume of diatomite ("Red Dog," "Sil-o-Sel" or similar) is added during the mix.

The mix will yield about $2\frac{1}{4}$ cubic feet of mortar, or enough to cover one stall to a depth of 1.5 inches. When properly placed and aged, this will transmit about one-half as much heat as the same thickness of ordinary concrete.

To further test the value of these cement-sawdust mix floors, the Oregon Experiment Station plans to use this material in several stalls in its new dairy barn now in the process of construction.—*Hoard's Dairyman.*

The Production and Handling of Milk and Cream.

By The Dairy Branch.

"*Quality is never an accident; it is the result of good workmanship, conscientious effort and intelligent management.*"—(National Butter and Cheese Journal, 10th January, 1937).

(*Continued.*)

TREATMENT OF MILK AND CREAM IN THE DAIRY.

1. THE SEPARATION OF MILK.

It is not proposed to discuss in detail the principle and operation of the cream separator, as hand books are supplied with these machines, and dairymen should study and follow the instructions contained therein as closely as possible. A few words, however, as to the general requirements for efficient separation and the reasons for variation in cream tests may not be out of place.

GENERAL REQUIREMENTS FOR EFFICIENT SEPARATION.

1. **Smoothness of Running.**—This is essential for efficient skimming. When a separator is running the bowl should spin like a top with no vibration. Any tendency to vibrate causes a partial re-mixing of the cream and skim-milk in the bowl and consequent loss of fat through the skim-milk outlet. To ensure smoothness of running it is essential that the separator should be mounted on a solid, stable base and that it should be absolutely level. To guess that the foundation is level is useless. A carpenter's level must be used and the machine

bolted down on this level foundation in such a way that it remains absolutely solid. It is advisable also to place rubber or wooden cushions between the base of the separator and the foundation to absorb any vibration. Any tendency to vibrate will be quickly observed by watching the surface of the milk. A frequent reason of vibration is the worn out condition of the mounting of the bowl. The bearings should be clean and well lubricated at all times. In cleaning the bearings petrol or paraffin oil can be used to remove any grease that may have become gummy. Only the best brands of lubricating oils should be used for lubrication, as inferior oils cause over-heating and wearing of the parts, which leads in turn to vibration. Ordinary machine oil will not do, as a thin oil is required.

2. **Speed of the Separator.**—Every separator has a given speed at which maximum skimming efficiency is attained, and this speed—which is usually stated in the directions enclosed with the machine—should be maintained uniformly at each separation. Most modern separators are equipped with a device, usually a bell, which indicates when the speed is not normal; as a rule the bell rings as long as the machine is being turned at too low a speed, but this does not prevent irregular turning or turning at too high a speed, especially when, as is invariably the case, the machine is being turned by a native boy. The operation should always be supervised and the speed of turning checked with a watch or speed indicator. A rough idea as to whether the correct speed is being maintained can be derived by watching the cream as it leaves the cream spout. If the cream turns in under the spout the speed is excessive for the amount of milk in the bowl; if the cream shoots out the machine is being turned too slowly; when the cream falls almost, but not quite, straight from the spout, the speed is about right.

If the separator is turned at too low or too high a speed skimming efficiency will be impaired and butter-fat lost in the skim-milk, whilst turning at varying or irregular speeds will lead to a corresponding variation in the richness, *i.e.*, the butter-fat content of the cream. The effect of turning the

separator at different speeds on the butter-fat content of the cream is shown in the following table.* The fat content of the milk and its temperature when separated were exactly similar in each case.

Speed of Separator Handle. Revolutions per minute.	Percentage of Butter-fat in cream.
74	52
60	34
Irregular	27
40	20

Such discrepancies in the percentage of butter-fat in cream from milks similar in every respect are remarkable and should make any farmer hesitate when inclined to throw the onus of varying cream tests on to the tester of the cream at the creamery.

3. **Rate of Inflow.**—The rate at which the milk flows into the bowl of the separator has a marked effect on the skimming efficiency of the machine. If the rate of inflow is excessive the milk passes too rapidly through the bowl and there is a consequent loss of butter-fat in the skim-milk, whilst if the rate of inflow is reduced the process of separation is prolonged without in any way increasing the efficiency of the machine. The most common device for regulating the rate of inflow is a hollow tin float which operates in the receiving cup under the tap of the milk tank; if too much milk flows into the bowl the cup fills up and the float rises partially shutting off the flow of milk from the milk tank. This float is provided by the makers for a specific purpose and should not be tampered with or removed. The rate at which the milk enters the bowl also affects the richness of the cream, the butter-fat content of the latter increasing as the rate of inflow decreases, *i.e.*, an increased rate of inflow produces thinner cream.* Incidentally the separator float, if roughly handled, is liable to develop a leak and foul milky matter will then accumulate inside it in a short time and contaminate any milk with which it subsequently comes into contact. A leaky separator float is a frequent cause of second and third grade cream.

4. **Temperature and Condition of the Milk.**—For efficient skimming, milk should be separated as soon after milking as possible before it has time to cool or the cream to rise. The best results are obtained when the temperature of the milk approaches that of the animal body. In all cases the milk should be separated at a temperature of at least 90° F., and if less than this the milk should be warmed up. The heating should be gradual, particularly so when the milk is several hours old. The effect of the temperature of the milk when separated on the butter-fat content of the cream is shown by the following figures.*

Temperature of Milk.	% Butter-fat in Cream.	% Loss of Butter-fat.
90° F.	42	0.06
80° F.	51	0.08
74° F.	52	0.10

It is evident that separating at a low temperature produces a richer cream and that at temperatures approaching 80° F. and below there is a considerable loss of butter-fat in the separated milk. It frequently happens on cold windy days that the milk enters the separator at a temperature of 84° F. or 85° F., in which case the test of the cream may be higher than that obtained on previous and possibly warmer days.

Milk which contains impurities or which is in a sour curdy condition will not separate completely; large amounts of slime are deposited in the bowl, preventing the passage of the milk and cream, and there is also a considerable loss of fat in the skim milk.

5. **Condition of the Separator.**—In order to perform efficient work the separator must be clean. After each separation the machine should be dismantled and cleaned at once. The parts should be rinsed first in lukewarm water and then scrubbed in hot water, and finally scalded or steamed. Before the next separation all parts of the separator should be scalded again and the machine should not be put together until required.

6. **The position of the Cream or Skim-milk Screw.**—Every separator is fitted with a device which regulates the richness

*Bulletin No. 530. Causes of Variation in Cream Tests. Department of Agriculture, S.R.

of the cream. In most modern separators this regulating device acts on the cream outlet, *i.e.*, the cream screw is adjustable; if a rich cream is required the screw is turned inwards, whilst a thin cream is obtained by turning the screw out. In some machines the regulating devise acts on the skim-milk outlet, and in this case a rich cream is obtained by turning the screw outwards and *vice versa*. Whatever machine is used it should be borne in mind that a half turn either way of the regulating screw will have an appreciable effect on the butter-fat content of the cream. Within fairly wide limits the adjustment of the cream screw, *i.e.*, the butter-fat content of the cream does not affect the skimming efficiency of the separator to any appreciable effect. Most separators will perform efficient work when discharging a cream testing 35 per cent. to 50 per cent. of butter-fat; above this point, however, separation may not be quite so exhaustive and there is usually a greater loss of butter-fat.

Many dairymen seem to be under the quite erroneous impression that once the cream screw is adjusted the butter-fat content of the cream should remain constant; it has already been shown, however, that variations in the test can be caused by variations in the speed at which the machine is turned and in the temperature at which the milk is separated, etc., but even if these factors remain constant, variations in the richness of the cream may still occur, if, as is quite commonly the case, there is any variation in the butter-fat content of the milk; in fact, the richness of the milk directly influences the richness of the cream, and other things being equal a rich milk will produce a cream of higher butter-fat content than a poor milk. Many dairy farmers do not realise that, milk, even that produced by the same cow, may vary considerably as regards its butter-fat content.

In one case a cow was found to give milk testing as low as 1.2 per cent. butter-fat in the morning and 6.7 per cent. the same evening. This, of course, was an extreme case, but nevertheless variations even of mixed milk are quite common and may be accounted for in many ways. Bad milking is a fruitful cause of variation, and in this country where a considerable percentage of the farmers allow the calves to suck on the cows the percentage of butter-fat in the milk will depend largely on the manner in which milking operations

are carried out. The last milk or strippings of the cow is very much richer than the first milk, and on the days that the cows are milked fairly dry the milk will be fairly rich in butter-fat and a high testing cream will result. On such occasions as wet days or Sundays when the milking is frequently done in a hurry, not only will less milk be produced, but its butter-fat content will be lower and a low testing cream will result. In the early spring, milk produced on the average Rhodesian farm is usually deficient in butter-fat and a low testing cream can therefore be expected. In the winter cream tests are as a rule on the upward grade; not only is the milk richer, but the milk cools down more rapidly, and as shown, the test of the cream from milk separated at low temperatures is higher than that separated when warm.

It is necessary in this connection to point out that it is not advisable for dairymen who supply cream to a creamery to separate cream of too high or too low a butter-fat content. Cream of too low a fat content has poor keeping qualities. The fermentations which take place in cream develop chiefly in the serum or liquid portion, and it follows that the higher the fat content the less the amount of liquid in which fermentation can take place. All things being equal, therefore, a rich cream should keep better than a cream of low butter-fat content.

Thin cream, *i.e.*, cream testing under 35 per cent. or 40 per cent. butter-fat, invariably arrives at the creamery in an over-ripe and curdy condition. Such cream is not only difficult to sample and test but also has the disadvantage that it reduces the amount of skim milk available for feeding calves and pigs and increases the cost of transport per lb. of butter-fat. Excessively rich cream on the other hand, *i.e.*, cream testing over 50 per cent. butter-fat, is undesirable, for such cream is not only heavy bodied and therefore difficult to sample and test but it is also inclined to be fatty and to produce a fatty or greasy butter, particularly if, as is frequently the case, the cream has been overheated en route to the creamery. The creamery, for economical working and the production of good butter, requires cream of medium consistency. Generally speaking, dairymen should aim at separating a cream testing about 45 per cent. butter-fat during the summer months whilst during the winter this can be reduced to about 40 per cent.

THE PROCESS OF SEPARATION.

In separating milk, the following procedure should be observed:—

(1) Scald all parts of the separator, which should have been cleaned and sterilized after the previous separation, and set the machine ready for the process.

(2) Flush the receiving tank and bowl of the separator with a gallon or so of boiling water and start turning at the same time. The hot water lessens the vibration, warms the bowl and prevents the cream from sticking to the plates.

(3) When there is no more hot water in the receiving tank the latter should be filled with milk; if the milk has been properly strained and if separating operations are carried out in a clean dust-free atmosphere free from flies, then further straining of the milk as it enters the receiving tank of the separator should not be necessary. It is, however, a common practice to strain the milk into the receiving tank through butter muslin or a proper milk straining cloth. The temperature of the milk should not be lower than 90° F.

When the correct speed is attained the faucet from the receiving tank into the bowl can be opened and the milk allowed to flow into the bowl.

(4) Separate into empty vessels which have previously been cleaned and sterilized. Enamel pails are suitable vessels for receiving the cream, but unfortunately they do not last; tinned, seamless pails of the type illustrated in figure 15 are quite satisfactory and far more durable.

The water used for the preliminary flushing of the bowl should not be allowed to run into these receptacles and under no circumstances should cream be collected in the vessel containing the cream from the previous separation.

(5) After separation is completed a gallon or so of separated milk is passed through the machine to remove the remnants of cream and the bowl is then flushed with cold or warm water to loosen the slime and dirt deposited during separation so as to facilitate subsequent cleaning.

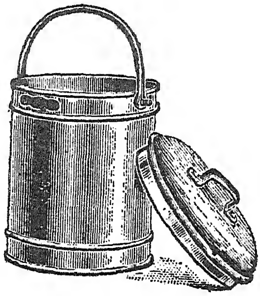


Fig 15.
Seamless container for collecting cream at the separator.

Fig. 21.
Squeegee, for removing remnants of cream from receptacles, stirrers, etc.

This separated milk or water should not be allowed to flow into the cream, for obviously it will not only dilute the cream and lower the test, but it will also carry into the cream some of the slime and impurities from the bowl, particularly if hot water is used. This is a matter which is frequently overlooked, with the result that the cream when delivered at the creamery is found to contain dirt or slimy matter deposited therein during the process of separation.

2. THE COOLING OF MILK AND CREAM.

Immediately after production or separation the milk or cream should be cooled to a low temperature. This is essential irrespective of whether the milk or cream is to be consumed as whole milk or cream or whether it is to be sent to a cheese factory or creamery, etc., for manufacturing purposes. As previously stated, bacterial growth and multiplication is very considerably retarded at a temperature of 50° F. and below, whilst at temperatures of 70° F. and above growth and fermentation take place with considerable rapidity. Every effort should be made therefore to cool the milk and cream to a temperature as near as practicable to 50° F. or below in order that it may reach the consumer or the factory in a satisfactory condition. Unfortunately the necessity for cooling is not fully appreciated by Rhodesian dairy farmers, many of whom make no effort whatsoever to cool their milk or cream or to keep it cool, with the result that when it arrives at the factory or creamery, bacterial fermentation—usually of an undesirable type—is well established, or has at least commenced. Tests

carried out from time to time show that during the summer months cream is frequently delivered to the Railways at temperatures as high as 80° F. to 85° F. It is not possible even with the most modern equipment and appliances to convert milk or cream handled in this manner into the finest grade of butter or cheese.

The cooling of milk and cream to temperatures approximating 50° F. or 55° F. may be quite practicable during the winter months, but it is not possible, on the average farm in this Colony, to cool milk or cream to such a low temperature during the warm weather without the aid of a special cooling plant. It should, however, be feasible to cool milk and cream to temperatures around 60° F. by the use of cold water and proper coolers of the type illustrated in figures Nos. 16 and 17, where the milk or cream passes over the surface of the cooler in a thin layer and is cooled by cold water which circulates through the interior of the cooler. This system has the additional advantage that the passage of the milk or cream over the cold surface of the cooler promotes aeration and helps to eliminate foreign flavours and odours. The lower the temperature of the water which is used for cooling the better; during the warm season of the year it may be necessary to cool the water by the use of canvas bags or by passing it over a charcoal water cooling tower. The latter is built of fairly large pieces of loosely packed charcoal held by wire netting and is usually three feet wide at the bottom and tapers to the top, the height being about five feet; the water after passing over the tower, which should be placed at some height above the ground, may be collected in a cement tank, from which it can flow to the cooler.

Experiments have shown that water of a temperature of 90° F. when filled into a 10 gallon canvas bag in the evening had a temperature of 60° F. the following morning after standing in a draught overnight, whilst lower temperatures, i.e., 50° F. to 55° F can be attained without difficulty during the winter months.

If a cooler of the type illustrated in figs. 16 and 17 is used, then it should be possible to cool the milk or cream to a temperature within 4° or 5° F. of the temperature of the cooling water.

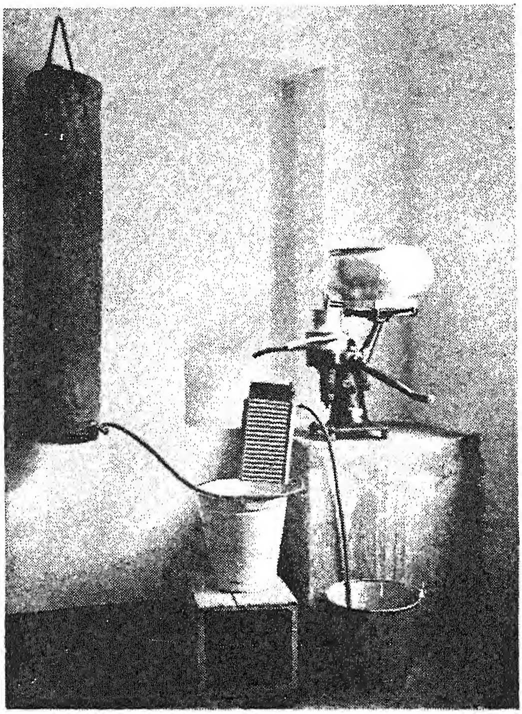


Fig. 16.
Cream cooler in operation showing (1) water bag. (2) cooler and (3) cream receiving bucket.
(Photograph by S. T. Timson, Esq.)

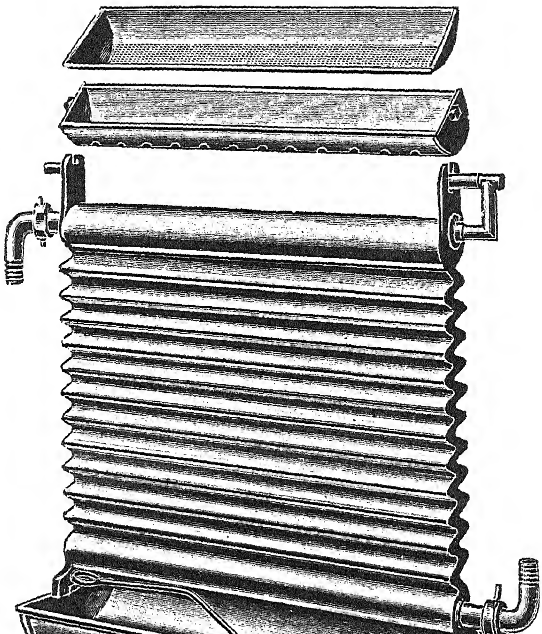


Fig. 17.—Milk Cooler.

Producers who supply milk on a large scale, particularly dairymen who conduct a retail trade, would be well advised to instal a small milk cooling plant of which there is quite a number on the market to-day. These consist usually of a refrigerator unit, including a milk cooler, and in some cases a cold storage cabinet in which milk, cream or other dairy produce can be kept pending use or despatch; the cost of these plants is not excessive when the results obtained are taken into account.

Milk or cream may be cooled by various other methods, such as standing the cans in a cement tank through which cold water is flowing; cooling by this process, however, is slow as compared with the results obtained by using proper coolers. There is, however, no excuse for dairy farmers to leave their milk and cream to stand and cool by itself, as is quite commonly the case.

Small cream coolers of the type illustrated in fig. 16 are quite inexpensive and have proved very satisfactory in practice. Experiments have shown that when these coolers are used it is possible to affect an almost instantaneous reduction of 14° F. to 20° F. in the temperature of the cream, and that in order to affect a similar reduction in temperature by other recognised methods of cooling, such as placing the cream in a charcoal safe or standing it in water in a draught—or even placing it in a refrigerator—a period of from 4 to 7 hours is required, depending on the quantity of cream which has to be cooled. Many dairyment are under the impression that cream will cool rapidly enough if placed in a charcoal safe or refrigerator, but this, as indicated above, is not the case. Rapid cooling is essential if bacterial fermentation is to be checked, and this can most easily be effected by the use of cold water and a cooler of the type illustrated, *i.e.*, the cream should be cooled before it is placed in the refrigerator or charcoal safe.

The cream coolers illustrated have the further advantage that as they are small in size they can be placed under the cream spout of the separator so that the cream can pass from the cream spout over the cooler into the cream receiving vessel. A 10 gallon canvas bag will provide sufficient cold water for

a small cream cooler suitable for use on the average dairy farm. After cooling, every effort should be made to retain the temperature to which the milk or cream has been cooled. In the absence of a refrigerator in which to keep the cream when cooled use has to be made of other cooling devices such as the following:—

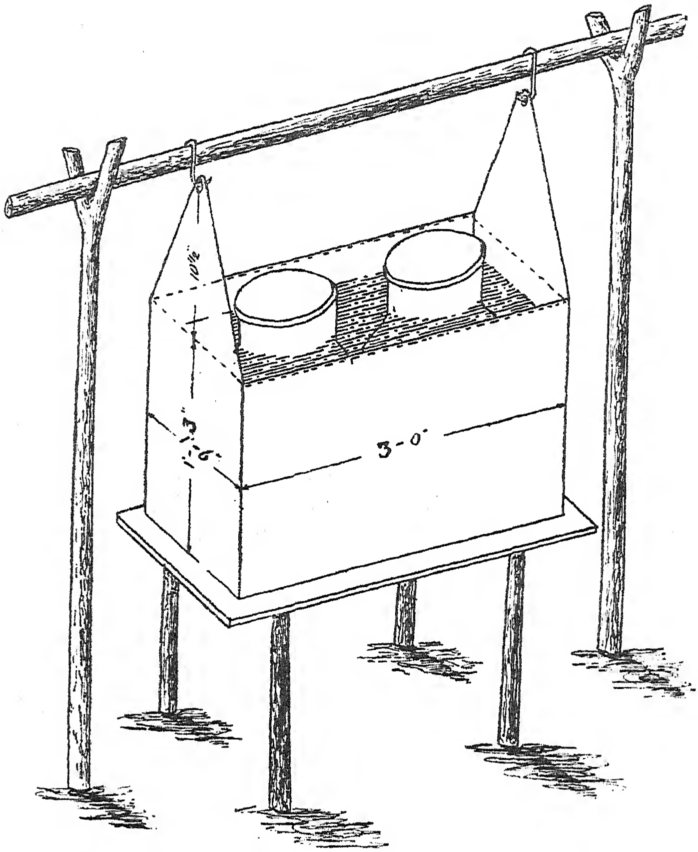


Fig. 18.—Canvas water trough for keeping cream cool.

1. A coarse cloth such as cheap native blanket, or preferably towelling, is tied or fixed round the vessel or receptacle containing the cream, which is then placed in a dish, trough or tray containing about 4 to 5 inches of cold water and stood in a draught, *e.g.*, opposite to an open window facing, for preference, in an easterly direction. The cloth should cover the whole surface of the container, leaving the top open, the

latter being covered with butter muslin. By means of capillary action the cloth or blanket will be kept damp whilst the draught will cause a continual evaporation with consequent lowering of the temperature of the cream in the container. The cloth must be kept wet otherwise the device is quite ineffective.

2. Another device for cooling cream or for keeping cream cool consists of a canvas trough which is used as illustrated in fig. 18. The trough is 3 to 4 feet long, 18 inches wide and 15 inches deep. As the weight of the water and of the cream containers is considerable a support on which the trough can rest, as shown in the illustration, will have to be constructed at such a height that dogs and other animals will not be able to tamper with the contents of the cans. The trough should be placed outside in the shade of the verandah of the dairy or under a shady tree in an exposed position so as to get all the breeze which is blowing. If the trough is properly constructed the temperature of the water in which the cream containers are immersed should not exceed 65—70° F. even on a warm day. If, however, this temperature is exceeded then it would be advisable to remove the cream containers to the dairy and keep them under the conditions described above. They may be placed outside again during the night in the canvas cooler. The mouth of the containers should be covered with butter muslin.

3. The cream when cooled may be kept cool by being placed in a charcoal safe of the type illustrated and described in the Agricultural Department Bulletin No. 908. These safes have proved quite satisfactory in practice, but they have the disadvantage that they are commonly used not only as a storage place for milk and cream, but also as a repository for various other products such as meat, bacon, vegetables, etc., all of which are liable to impart a taint to cream or milk.

STORAGE, MIXING AND DESPATCHING OF CREAM.

Whatever method is adopted for keeping the cream cool it is essential that the latter be stored in a clean place away from any fruit, meat or other materials likely to cause taints. Flies, dust, etc., must also be excluded. When the cream is cooled it can be mixed with the cream obtained from the

previous separation. Warm cream should never be mixed with that which has already been cooled. This is a primary cause of "fermented flavour," a common defect of Rhodesian cream. When mixing different lots of cream of varying degrees of ripeness, they should be stirred vigorously to ensure thorough mixing and uniform ripening; this also applies to cream that is being cooled or ripened; the latter should be stirred frequently—at least three times a day—and stirring on each occasion should be thorough; by thorough stirring is meant vigorous stirring for at least a minute—not a few turns with a small spoon or stick. For this purpose a metal stirrer of the plunger type illustrated in fig. 19 should be used. The action of a spoon or stick in stirring is to cause the cream to move in a circular motion, but not to mix, whereas a metal stirrer of the type shown mixes and stirs the cream more thoroughly by bringing the cream at the bottom of the vessel up to the top and exposing it to the air. Fig. 20 illustrates the difference between the action of the straight and plunger type of stirrer.

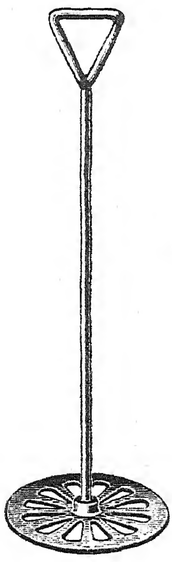


Fig. 19.
All Metal Cream Stirrer.

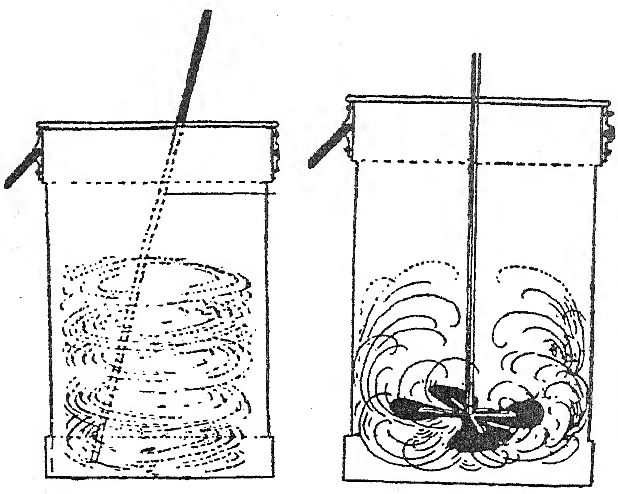


Fig. 20.
On left, showing action of stick in cream. On right, showing action of plunger. (Adapted from milk and cream testing by G. S. Thomson).

The necessity for frequent stirring is not fully appreciated by the average cream supplier. Frequent stirring

prevents lumpiness, promotes uniform ripening and a smooth consistency, and by aerating the cream assists in expelling undesirable odours. Neglect to stir the cream whilst cooling or ripening may result in a lumpy, curdy texture and a stale, musty or bitter flavour.

Milk and cream are perishable products, and for this reason it is essential that they be despatched so as to arrive at the creamery or factory, etc., in as fresh a condition as possible. Cream which has been cooled to 70° F. and kept at this temperature for 36 hours is generally ripe enough for churning, so that it is obvious that a great deal of Rhodesian cream arrives at the creamery in an over-ripe condition, particularly during the warm season of the year. Every effort should be made to send cream to the creamery at least three times a week. If daily deliveries can be made so much the better. Fortunately it is now possible, as the result of improved transport services and facilities, for producers in certain areas, to send their cream almost daily to the creamery. Many dairymen, however, seem to be under the impression that, provided the cream can be sent daily to the creamery, it is not necessary to exercise any particular care in the methods of production or to cool the cream and to keep it cool after separation. It is quite possible, however, for fresh cream to be "Second Grade" or "Third Grade" on arrival at the creamery if it has not been cooled before being placed in the can or if it is tainted or has been produced and handled under unclean conditions.

In filling the cans with cream, care should be taken to see that the can is filled as full as possible with cream—to within at least an inch of the lid. Small cans which can be completely filled with cream are to be preferred to large cans which can be only half filled. Cream in half-filled cans is very liable to be shaken and jolted about in transit and arrive at the creamery in a "churned" condition.

When transferring cream from one receptacle or container to another, *e.g.*, when filling a cream can, the remnants of cream adhering to the insides of the receptacle or container can most easily be removed by means of a rubber "squeegee." See fig. 21.

For sealing the lids of the cans, wire—preferably baling wire—should be used. There is no necessity to use thick stiff fencing wire. While in transit to the creamery or railway siding the cans should be protected from dust and the hot rays of the sun by means of wet cloths, blanket or hessian. Fig. 22 illustrates what frequently happens in practice and shows cans of cream arriving at a railway siding without any covering or protection from the heat of the sun. In some cases the cans of cream are conveyed as shown, without any covering whatsoever over a distance of 8 or 10 miles—a journey which would probably take $2\frac{1}{2}$-$3\frac{1}{2}$ hours to complete. Cream which has been exposed to the heat of the sun in this manner cannot possibly be "First Grade" when it arrives at the creamery.

Cream which is conveyed by road motor service should not be allowed to stand exposed to the rays of the sun at the various motor halts—see fig. 23—but should be placed in the shade of a tree or preferably in a special cream shelter of the type illustrated in figs. 24 and 25.

SOME COMMON DEFECTS OF CREAM.

It is the usual practice in this Colony for the creameries to indicate on the farmer's cream receipt the reason why his cream has been graded as Second Grade or Third Grade, etc. Many farmers, however, do not appear to understand the meaning of the descriptive terms used by the creamery graders and it may be helpful therefore to indicate briefly the meaning of a few of the terms more commonly employed and the causes and remedies of the defects to which they refer.

1. **Unclean Flavour.**—An objectionable foreign flavour usually caused by the use of dirty utensils and unclean methods of milking. Dirty cans and dirty separators are fruitful sources of off-flavours. The flavour may be imparted to the cream directly through the incorporation of particles of dirt, manure, etc., in the cream. These substances carry large numbers of putrefactive bacteria, which produce unclean flavours and odours.

Cream stored in close proximity to any foul smelling substance is liable to develop off-flavours. The remedy for this defect lies in the application of clean methods of produc-

Fig. 22.—What frequently happens in practice. Natives arriving at railway siding with cans of cream. Note absence of covering on cans to protect cream from the heat of the sun. Cream transported in this manner cannot possibly be First Grade when it arrives at the creamery.

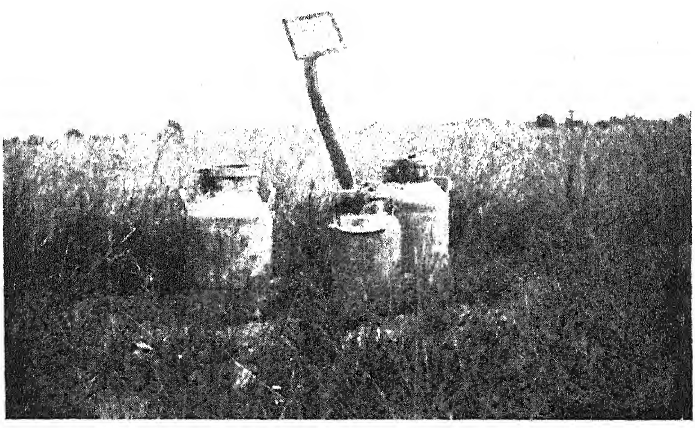


Fig. 23.—Another common practice. Cans of cream standing exposed to the heat of the sun at a road motor halt.

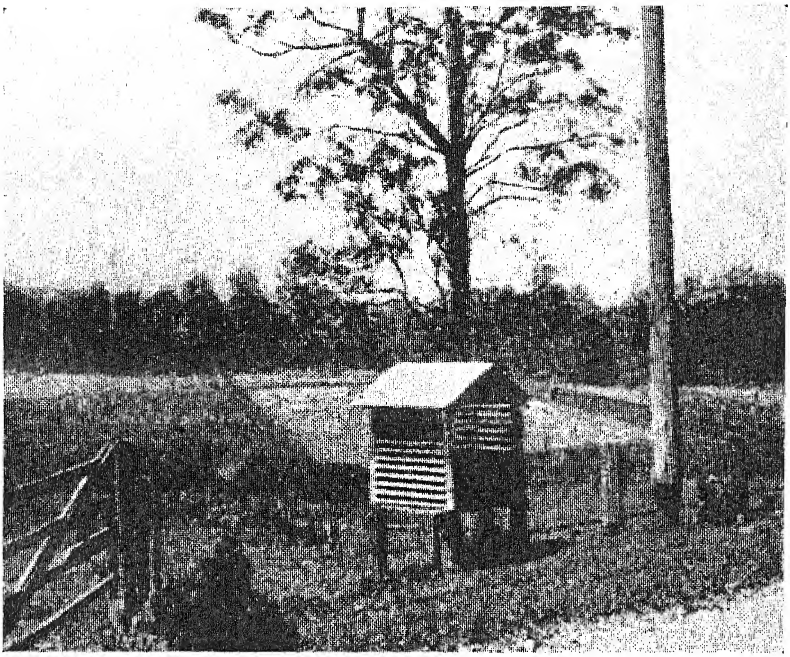


Fig. 24.—Cream shelter for cans of cream awaiting collection at road motor halts.

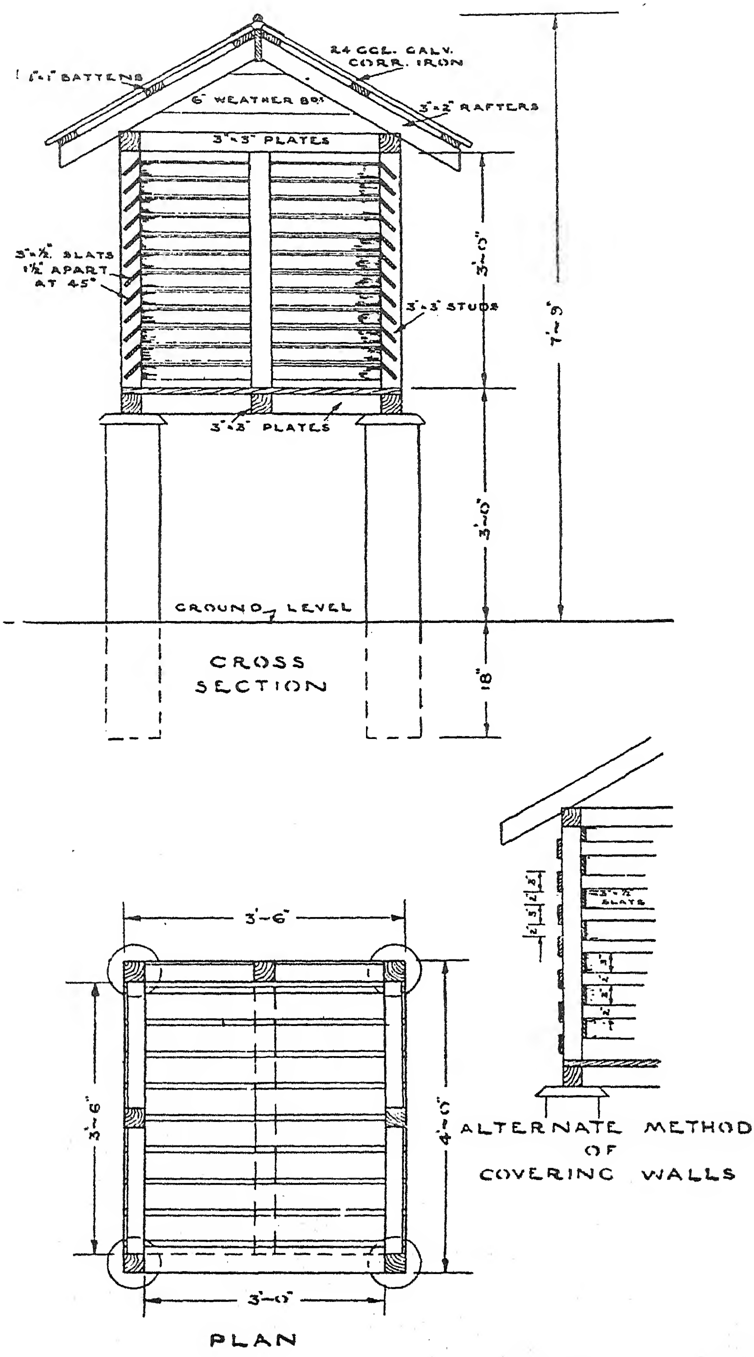


Fig 25.—Plan and cross section of cream shelter illustrated in Fig. 24.

tion and handling. The cattle should be milked under clean conditions; cans when received from the creamery should be cleaned and sterilized and then aired.

2. **Over-ripe Cream.**—This is probably the most common defect of cream produced under local conditions.

An over-ripe flavour in cream is a very pronounced sour flavour. Cream of this nature has been decomposed to such an extent that it cannot be made into first grade butter. This defect invariably occurs in cream that has been stored at high temperatures, or for too long a period before reaching the creamery. Warm weather is favourable to the rapid decomposition of cream, and for this reason an over-ripe condition is most prevalent during the latter months of the year. Neglect to cool the cream after separation is another cause of this defect.

The cream should be kept cool in transit by covering the cans with wet sacks or blankets.

3. **Stale Flavour.**—A stale flavour is frequently found in over-ripe cream, or cream that has ripened too quickly. A frequent and possibly more common cause of staleness is the use of rusty cans, petrol and paraffin tins for storing cream. The flavour is sometimes noticed in cream obtained from cows far advanced in lactation—*i.e.*, in winter, when there is a lack of flavour-producing substances in the natural veld grass. Cream cooled and ripened in clean, non-rusty receptacles rarely shows this defect. Rusty cans should be re-tinned or destroyed.

4. **Musty Flavour.**—This is a fairly common flavour in cream and is caused by any one of the following: lack of prompt cooling and aeration of the cream, neglect to stir the cream, storing cream in damp, musty, poorly ventilated surroundings, in closed cans, or in close proximity to mouldy, musty food, etc., or feeding musty hay or mouldy ensilage.

To prevent the occurrence of this defect cream should be promptly cooled and placed in a clean receptacle in a clean, cool atmosphere. The cream must be stirred frequently, and should be covered with clean butter muslin.

5. **Fermented Flavour.**—This flavour results from a bacterial fermentation and is a common defect of Rhodesian cream. The organisms responsible are usually present in cream, but they do not develop and produce a fermented flavour at low or moderate temperatures. The defect is most common during the warmer months of the year when cream is exposed to relatively high temperatures for considerable periods.

This defect is frequently accompanied by gas formation, which may be so excessive as to cause the lids of the cream cans to blow off and the cream to foam over. Cream of this nature cannot be made into first grade or even second grade butter. A primary cause of this defect is the mixing together of warm and cool cream—a very common practice among cream producers.

The prevention lies in prompt cooling of the cream, never mixing creams until equally cool, keeping the cream cool in transit, frequent shipping to the creamery and by the elimination, as far as possible, of the original source of contamination. Muddy kraals and dirty cows, mud crusted flanks and udders, and dirty utensils are the chief sources of the organisms causing this flavour in cream.

6. **Bitter Flavour.**—This is a fairly common flavour and its presence in cream may be due to any one of the following: Cows in an advanced stage of lactation frequently yield milk which has a bitter taste; certain feeds and weeds produce bitterness, *e.g.*, rye, rank sedgy grass, mouldy feed stuffs, etc., and, or, the flavour may be produced by certain organisms frequently found in milk.

These organisms thrive best in the absence of air, and for this reason frequent and thorough stirring of the cream tends to retard their development—in fact, neglect to stir the cream may be regarded as the most common cause of bitterness. Cream should be stirred at least three times a day.

7. **Cheesy Flavour.**—This is a flavour reminiscent of the flavour of cheese, and is invariably found in cream which is very thick or over-ripe. The cream is frequently curdy. Cream showing this defect cannot be used for the production of first or second grade butter. Neglect to stir the cream whilst ripening is a common cause of this defect. Cream should not be over-ripe.

8. **Cowy Flavour.**—This flavour suggests contamination of the cream with manure and stable air. Cream frequently has a cowy odour, but this in itself is not such a serious defect, as the odour usually passes off when the cream is aerated, although it indicates careless methods of production and unclean stables. A cowy flavour, however, usually indicates bacterial contamination, and is most undesirable. The organisms which cause the cowiness in the stable are present in the cream.

Milk standing in pails in the stable is liable to develop a cowy flavour. The flavour is quite often the result of the use of "beestings" or "colostrum"—*i.e.*, the milk secreted by a cow immediately before, and for some days after calving. Beestings have a decidedly "cowish" taste, and for this reason no milk from a newly calved cow should be mixed with other milk until at least eight days have elapsed from calving.

Clean methods of milking and handling the cream prevent the occurrence of this flavour.

9. **Rancid Flavour.**—This flavour is common during the warm season of the year. As a rule, rancidity is caused by bacterial agency, although it is frequently the result of chemical action—decomposition of the butter-fat. The bacteria commonly causing rancidity are usually associated with dirt of various kinds, so that the application of clean methods is the best remedy for this defect.

Cream that is kept too long, and which is over-ripe, tends to show rancidity.

10. **"Weedy" and "Tainted" Cream.**—Generally speaking these terms are used to designate flavours which are considered to be caused by foodstuffs, plants, weeds, etc., that the cows have eaten. At times, however, it is not easy to say whether a taint which is present in cream has been caused by some weed or plant which the cattle have eaten or whether it has been absorbed by the cream from its surroundings or from some foreign matter with which it has been in contact or whether it has arisen as the result of bacterial fermentation. There are certain bacteria—which may gain entrance to milk from vegetation, water or utensils—which are capable of producing flavours which are identical or at least very closely resemble, the flavours imparted to milk and cream by plants and other agencies. A fruity flavour may arise as a result of bacterial action or it may also be caused through the cows eating decaying "marula" fruit. Other species of bacteria produce mouldy flavours, fishy, turnipy and cabbagy flavours and so on.

Experiments which have been carried out so far indicate that the methods of processing commonly applied in dairy factories are not very effective in removing plant flavours—in fact, in some cases the taint becomes intensified with treatment. As far as this Colony is concerned very little is known regarding the plants, bushes, etc., capable of causing taints in milk, cream and dairy products, although it is fairly well established that taints can be caused by the following:

1. *Trees.*—Marula, Mahobohobo. Taint caused by cattle eating decaying fruit.

2. *Weeds.*—Khaki bush or Mexican Marigold, the "dwarf" Marigold, Fleabane, Blackjack, "Stinkblaar," "Garlic," or the so-called "wild onion," "mint weed," or "wild mint," and certain species of Chenopodium.

Thorough stirring and aeration of the cream will help to remove some of these flavours, but the only effective way of eliminating these taints is to eliminate the cause or to see that

the cows do not have access to any weeds or bushes, etc., capable of causing these foreign flavours.

Decayed and mouldy feeds may also produce "off-flavours" in milk and cream, and should for this reason be excluded from the ration feed to the milking cows.

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An Unusual Winter Outbreak of Maize Weevil

(*CALANDRA ORYZAE*, L.).

By M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.

Towards the end of July it became evident that infestation by maize weevil, *Calandra oryzae*, L., was unusually heavy for that time of the year. Within a given time the Maize Control Board had to meet commitments of clean maize made some months earlier at very favourable prices that were no longer available for new contracts. With great difficulty and considerable effort on the part of the maize grading staff, the necessary quantity of clean maize was found, but it was felt that an investigation into the causes of the outbreak might lead to information that would be of value in selling "futures," or at least prove useful in further investigations.

It should be mentioned that maize arriving for delivery and graded as "slightly weevily" is not usually obviously infested. Indeed, an obvious infestation is usually a fairly heavy one. The practice in grading is to watch for adult weevils, weevil damaged grain, and weevil dust. In a season such as 1937 when the maize is exceptionally dry and easily broken, dust may be of two kinds, namely, weevil dust and dust rubbed from broken grains. However, experienced graders find that these are clearly distinguishable, and state that errors in grading on the basis of weevil dust cannot occur, as a grader may not, without authority, class maize in any degree weevily on the basis of the presence of this dust alone.

FIELD INFESTATION.

When maize, newly arrived from the farm, is graded as "slightly weevily," there can be no doubt that, with very few possible exceptions, the infestation has come from the farm. Investigations during the last three years in the Mazoe Valley

have established the fact that field infestation exists, and that it is mostly part of a cycle in which storage and shelling dump infestation gives rise to field infestation, and field infestation plays a large part in the infestation of store-rooms and shelling dumps. The part played by stooking has not yet been investigated, but is suspected of having some importance.

A questionnaire was sent to two hundred maize growers in the Mazoe district in August, and by the end of October over 100 had replied. As some replies were, for various reasons, incomplete, the answers used for compiling the information received varied from about 80 to 110. Figures must, therefore, be regarded as only approximate.

The information asked for was required in order to ascertain whether any unusual activities on the part of the growers was responsible for the outbreak of maize weevil in July, and to discover whether the outbreak was unusual in respect of time or in respect of severity. The replies to the questionnaire, together with other investigations, indicate that the outbreak was unusual chiefly in respect of time, and that, apart from this factor, farming activities may have caused some slight increase in severity.

MAIZE STORES.

As farm maize stores are known to be centres of field infestation, except where the grain is stored in air-tight tanks, or when other effective precautions are taken, information on the storage of maize was sought. As centres of infestation, unprotected stores may vary in importance with the amount of grain stored.

No. of Bags of Maize Stored.—Taking 1934 as a basis, the increase in the number of bags of maize stored on farms was as follows:—

1935.	1936.	1937.
3%	7½%	10%

The field infestation during 1937 would be affected by storage of the 1936 crop, and a slight increase is here noticeable. The increase in the number of bags stored in 1936, taking 1935 as a basis, was 4.4%.

No. of Farmers Storing Maize.—The increase in the number of farmers storing maize, taking 1934 as a basis, was:

1935.	1936.	1937.
6.8%	10.8%	13.5%

The increase in 1936, taking 1935 as a basis, was 3.7%.

Most of the maize stored was used for grinding on the farm, and about one quarter of those who ground their own meal also ground for one or more others. There has been no significant increase in the practice of grinding for others during the last four years. The bearing of this subject on the problem is that previous season's grain being transported during the ripening and harvesting period is liable to be a source of infestation on the lands adjoining the roads used. Sufficient evidence exists to show that roads and railways are sources of field infestation. During handling and transport, disturbance causes many adult weevils to make their way to the outside of the grain. These are dropped, or, in warm weather, they may fly away. (This weevil *can* fly, contrary to the belief of many growers.)

SHELLING DUMPS.

The previous season's shelling dumps as sources of field infestation should not be under-rated. Although an individual dump may not be as prolific a producer of weevils as are the maize stores, there are about three times as many dumps as there are farm maize stores. The degree of danger from shelling dumps is dependent on the previous season's field infestation, and on the treatment of the consequent shelling dump. Investigations concerning the best treatment of dumps have barely begun, and there is, as yet, no outstandingly preferable recommendation on the subject.

In theory, burning, if properly carried out, should be a very effective treatment, if the most wasteful. Proper burning does not consist of merely putting a lighted match to the dump. The material should be spread out over as much of the area covered by shelling operations as will allow of sufficient depth

to ensure a good, hot fire that will burn the cobs to ashes. The cobs should be placed on the top of the husks. In shelling, operations should be limited to as small an area as possible, so that subsequent treatment will be less costly and more effective. Burning should be done before the rains set in. To convert the routine to an occasion of family interest, burning might take place every Armistice Day, as is already done by at least one grower. Preferably, some occasion about a week or more earlier might be chosen, such as an anniversary of some public event, or a birthday.

Another theoretically effective method of treatment that has not been especially observed in reference to maize weevil control is the conversion of all the materials of the shelling dump into compost by the Indore method. The heat developed by fermentation would be sufficient to kill those weevils that cannot escape to the outside (and the immature stages cannot escape). When turning over the heaps in the process of composting, the outside portions should be moved first, so that any weevils present will be in the middle of the new heap, and will be enclosed by a blanket of hot compost. The soil used in composting should be the surface soil taken from within the area of shelling operations. Here again, the earlier the better —before the onset of the rains if water or other suitable liquid is available.

Answers to the questionnaire show that, whatever has been the treatment of shelling dumps by farmers in recent years, there has been no variation in treatment from year to year. The majority either burned outright, or fed to cattle.

Furthermore, the replies do not reveal very significant changes in the number or area of influence of shelling dumps in recent years. In analysing replies to the question in reference, shelling dumps and maize stores were each counted as one source of field infestation, except when the two were close together and would be affecting approximately the same lands, when they were counted as one.

The figures calculated from the replies are given in the following table:—

Centres of Field Infestation by Maize Weevil.

	1933.	1934.	1935.	1936.	1937.
Average number of infestation centres per farm	2.19	2.22	2.19	2.22	2.22
Average number of acres of maize contributing to each infestation centre affecting following crop...	162.5	159.2	156.8	160.1	159.8
Average number of acres of previous crop contributing to each current infestation centre	No figures	167.2	161.8	165.9	159.9

During the five year period the number of producing farms increased slightly, as did the total acreage grown. But the average number of acres grown per farm was consistent, varying between 353 and 356, with the exception of 343 in 1935.

The figures so far considered show a small increase in the potential field infestation, and the facts on which they were based may account for a slight increase in the severity of infestation in the 1937 crop. Unfortunately, no questions concerning the practice of stooking were asked. An increase in this practice may have had a significant influence.

SEASONAL INFLUENCE.

In seeking a possible seasonal factor, data regarding the time, relative to normal, of planting, ripening, and harvesting were obtained. The following figures were based on the information received:—

Date of Planting:—

25% of growers planted, on an average, about two weeks earlier;

64% of growers planted at the usual time;

11% of growers planted, on an average, about two weeks later.

Date of Ripening:—

75% of crops ripened, on an average, three weeks earlier;

18% of crops ripened at the usual time;

7% of crops ripened, on an average, three weeks later.

Date of Harvesting:—

42% of growers harvested, on an average, about $3\frac{1}{2}$ weeks earlier;

48% of growers harvested at the usual time;

10% of growers harvested, on an average, three weeks later.

The most significant deviation from normal is seen in the time of ripening, and this was originally considered the most important of the three questions. The unusually early cessation of rains presumably caused a premature drying of the unripened grain to a point where it was favourable to early infestation by maize weevil. With this early start it would be possible for the insect to produce an extra generation before harvesting took place, resulting in both a more widespread and a more severe infestation than is usual in July and August.

With the data obtained it is not possible to come to a conclusion without a certain amount of speculation. But the above theory seems reasonable, and is supported by the dryness of maize throughout the country. While examining maize newly arrived at sidings and stations from farms in the Mazoe district, the writer made 28 tests of different consignments for moisture content. These averaged 10.2%. To check up on this a dozen specially accurate laboratory tests of grain arriving from the Salisbury district were made. These averaged 10.5% moisture. Similar reports come from all over the country.*

But Agriculturists of the Department state that, in their experience, unusually early cessation of rains has led to a *reduction* in the incidence of weevil attack. Possible answers to the apparent contradiction are as follows, the writer being in favour of the second:—

*In normal years many farmers find great difficulty in delivering maize below the 12.5% moisture limit required.

If the practice of stooking has increased phenomenally during the past few years—and it certainly has increased—the early ripening of maize and consequent early stooking may have brought about conditions favourable to weevil. These conditions could not be prevalent during other early seasons experienced by the Agriculturists, on account of the smaller amount of stooking practised.

Alternatively, the unusually early cessation of rains and consequent early ripening during the seasons that the Agriculturists have in mind may have then occurred even earlier than it did during 1937, thus giving the grain sufficient time, before being shelled, to dry out to such an extent that it could no longer support weevil. The minimum percentage of moisture in Rhodesian maize at which weevil can persist has not yet been accurately determined, but is thought to be around 9 or 10%. Evidence that this critical point was being approached in August was seen by the writer, who found a fair amount of dead weevil in bags of maize and, more significantly, inside the grain itself. This led him to suspect that crops being delivered later would be less weevily. In confirmation of these suspicions, graders reported receiving more and more clean maize from the farms during September, October and November, whereas in normal years, weevil is becoming more and more troublesome during these months.*

CONCLUSIONS.

It, therefore, seems evident that the primary cause of the unusual outbreak was the early cessation of the rains and consequent early ripening of the crop, that the outbreak was unusual in point of time, but that the final result was a weevil infestation of smaller than average proportions. As a result of the investigation, however, it is proposed to include in further work a study of the influence of stooking on the incidence of field infestation by maize weevil.

ACKNOWLEDGEMENTS.

The writer would like to express his gratitude to those farmers who answered the questionnaire, and to officials of the Maize Control Board and the Department of Agriculture who were good enough to assist by constructive criticism and useful suggestions.

*In mid-November, since the above was written, a dozen tests for moisture in maize newly delivered in Salisbury from a farm averaged as low as 8.8%, varying between 7.6 and 9.3%. The maize was found to be free of weevil.

Price List of Forest-tree Transplants, Ornamental Trees and Shrubs, Hedge Plants. Creepers and Seeds.

OBTAINABLE AT THE GOVERNMENT FOREST NURSERY, SALISBURY.

1. Transplants of forest trees, etc., as far as in stock, are obtainable at the subjoined rates.

2. Orders should be addressed to the Conservator of Forests, Salisbury; or Manager, Forest Nursery, P.O. Box 387, Salisbury.

3. **All orders must be accompanied by a remittance in cash, bank note, postal order, draft or cheque, made payable to the Department of Agriculture, Salisbury. Under no circumstances will plants or seeds be sent out or taken away from the Nurseries unless paid for.**

4. All transplants are despatched at Rate 10 on railways at purchaser's risk. The transplants are watered as far as this is possible by the railway staff.

5. All prices quoted are for delivery free at any station or siding in Southern Rhodesia.

6. Purchasers of trees contained in tins either of 25 or 4 trees are requested to return the tins, carriage forward, to the nursery from which they were obtained, or to the Manager, Forest Nursery, Salisbury. If the tins are not returned within two months from date of issue, they will be charged for at the current rate of petrol tins.

7. No trees will be reserved unless specially booked. Orders will be executed in order of receipt as trees are ready for despatch. Every effort will be made to comply with instructions of purchasers.

8. Transplants of forest trees, when quoted at per 1,000, are grown in half paraffin or petrol tins containing 20 to 25 transplants. The average weight of each tin is about 25 lbs Height of transplants, about 3 to 12 inches.

9. Transplants of larger size, from 1 ft. to 3 ft., are also supplied four in a tin at per tree Weight of tin, about 25 lbs.

10. Shrubs and ornamental plants in single tins have a weight of about 5 lbs.

11. To purchasers of forest trees, the following reductions are made:—

(*a*) When the number exceeds 1,000, the price is £3 5s. per 1,000.

(*b*) When the number exceeds 5,000, the price is £2 14s. per 1,000.

(*c*) Special quotation for orders over 20,000.

12. Orders for seed are posted or railed free of charge.

13. Though every care is taken to supply trees and seeds true to name and of good quality, no guarantee can be given in this respect, more particularly in regard to seed.

14. Intending tree planters are invited to apply to the Conservator of Forests, Division of Forestry, Salisbury, for advice as to the most suitable trees for growing in the various climates and soils of the Colony, and on the best methods to adopt in the formation of plantations, wind breaks and shelter belts.

15. No responsibility taken after trees, shrubs, etc., have been accepted by the Railways. Any claim for loss or death should be made to the Railway Company.

16. This list cancels all previous lists.

Price of Transplants.—For convenience, the following symbols are used to indicate the purchase prices of transplants:—

A—Trees, 25 in tin, at 2s. 3d. per tin, £3 5s. per 1,000; £2 14s. per 1,000 for orders over 5,000.

C—Trees and shrubs, 4 in tin, at 4d. each.

D—Trees and shrubs, 4 in tin, at 9d. each.

E—Trees and shrubs at 9d. each; extra large up to 2s. 6d. each.

Botanical Name.	Common Name.	Remarks.	Price of trans-plants.	Price of seed. Lb.	Oz.
Callitris calcarata ...	Black cypress pine ...	Usually rather slow growing, but reaches a fair size and produces a valuable durable softwood. Suited for dry country planting, especially in sandy soil. Resistant to white ants. Good shelter for orchards, etc.	A. C.	15s.	1s.
Callitris glauca	White cypress pine ...	Similar to Callitris calcarata. Better for poor acid soils and ironstone kopjes.	A. C.	15s.	1s.
Casuarina Cunninghamiana	Beefwood	A fine large shade tree, suitable for avenues and narrow belts, but not recommended for timber plantations. Requires deep soil in drier localities. The foliage is useful for stock fodder, and the tree stands lopping well.	A.C.	...	2s. pkt. 1s.
Cedrela odorata		A rapid-growing tree similar to Cedrela toona, but with lighter foliage. Likely to do well on heavy soils, fairly free from frost. 30 to 40 feet in height.	A.		
Cedrela toona	Toona tree...	A rapid-growing, handsome, semi-deciduous tree, suited for moister localities where frost is slight. Yields a valuable soft timber. Recommended for plantations, as well as shade and ornament.	A. C.	15s.	1s.
Cupressus arizonica ...	Arizona cypress	A hardy evergreen tree, suitable for dry localities, but requiring a well-drained and rather deep soil. Useful for shelter belts and also for hedges when closely planted.	A. C.	15s.	1s.
Cupressus lusitanica ...	Portuguese cypress ...	A fast-growing cypress, producing an excellent softwood timber, but requires a moist, cool climate and a good soil. May well be used for shelter and hedges in favourable localities.	A. C.	5s.	6d.
Cupressus sempervirens, var. horizontalis	Common spreading cypress	A hardy cypress, suited for limestone as well as other soils. Not so frost or drought hardy as Cupressus arizonica. Suitable for shelter and hedges.	A. C.	15s.	1s.

Cupressus sempervirens, var. pyramidalis	Common upright cypress	An ornamental tree for gardens and cemeteries. Also useful as a shelter tree. Grows under similar conditions to the "var. horizontalis."	A. C.	15s.	1s.
Cupressus torulosa ...	Himalayan cypress... ...	A good tree for timber and shelter. Withstands much cold and drought. Not very soil exacting. Fairly frost-hardy.	A. C.	10s.	9d.
Eucalyptus botryoides	Bangalay	A large-leaved, heavy-foliaged gum. Quick growing. Suitable for granite and red soils. Withstands frosts, but not very drought-resistant.	A.	15s.	1s.
Eucalptus citriodora .	Lemon-scented gum ...	A clean-boled tree, producing an excellent timber. Leaves lemon-scented. Suited for wetter regions and on the better soils in the lower rainfall regions. Will not withstand much frost or drought. Flowers prolifically, rendering it very useful for honey production.	A.	15s.	1s.
Eucalyptus crebra... ...	Narrow-leaved iron-bark	A slow-growing, deep-rooting species, producing excellent timber. Suitable for well-drained soils in the higher rainfall areas. Withstands a certain amount of drought and light frosts. Will not thrive in an acid soil.	A	15s.	1s.
Eucalyptus globulus ...	Tasmanian blue gum...	A fast-growing tree, suitable for cool, moist areas with deep soils. Will not withstand drought, but is frost-resistant to a large extent. Produces a useful timber.	A.	15s.	1s.
Eucalyptus maculata ..	Spotted gum	One of the best trees for timber production or shelter in the wetter areas, being fairly hardy to drought but not to frost. Produces an excellent timber.	A.	15s.	1s.
Eucalyptus maideni ...	Maiden's gum	A very fast-growing, large tree, with bluish foliage in youth. Fairly drought and frost resistant. Will grow on poor soils if deep and well-drained. Produces a good, strong, useful timber.	A.	30s.	2s.

Botanical Name.	Common Name.	Remarks.	Price of transplants.	Price of seed. Lb.	Price of seed. Oz.
Eucalyptus melliodora	Yellow box...	A medium-sized tree, useful for shelter belts. Produces a tough, durable timber. Very resistant to drought and frost. Valuable for honey production, having abundant sweet flowers.	A.	15s.	1s.
Eucalyptus paniculata	Grey ironbark	A very good timber tree, with heavy foliage. Suitable for the moister regions, with a deep, fertile soil. Withstands some drought, but is frost-tender. Yields an excellent, hard, durable wood.	A.	15s.	1s.
Eucalyptus punctata ...	Leather jacket	A tree of fair size, yielding a good, durable timber. Adaptable as regards soil and climate, but will not withstand a dry cold climate.	A.	15s.	1s.
Eucalyptus robusta ...	Swamp mahogany	A quick-growing, shady tree, which requires a moist soil for best results, but will grow under fairly dry conditions, provided frost is not severe. Recommended rather for shelter belts than plantations.	A.	15s.	1s.
Eucalyptus rostrata ...	Red gum	Produces an excellent and durable hardwood. Withstands drought, heat, brak, flooding and a good deal of frost. One of the best species for planting in Southern Rhodesia, except in sour soil and wet mountain regions.	A.	15s.	1s.
Eucalyptus saligna... ...	Sydney blue gum	A fast-growing, useful tree, producing a useful medium hardwood. Thrives on deep, fertile soils in the heavier rainfall areas. Tender to frost and drought.	A.	15s.	1s.
Eucalyptus sideroxylon	Red ironbark	A fairly slow-growing species, suitable for dry, rocky, soils in the moister regions. Produces a good, durable hardwood.	A.	15s.	1s.
Eucalyptus tereticornis	Forest red gum	Similar to Eucalyptus rostrata, and can be planted along with it, except in areas liable to flooding and great heat. Perhaps not quite as drought-resistant.	A.	15s.	1s.

Grevillea robusta	Silky oak	A handsome tree which thrives best in moist, warm localities. Useful for ornament, shade and timber. Frost-tender and not resistant to drought. If the locality is unsuitable, it may grow well for several years and then die out.	A. C.	...	pkt. 1s.
Jacaranda mimosaefolia	Jacaranda	An ornamental tree with feathery foliage and abundant blue flowers, which appear in spring. Best development is attained in the moister regions, but the tree withstands drought to a surprising extent, and may be planted in the drier regions if the soil is reasonably deep and fertile. It is tender to cold and frost, and may need protection in its earlier youth. Semi-deciduous.	A. C.	20s.	1s. 3d. pkt. 1s.
Pinus canariensis	Canary Island Pine ...	Hardy to drought, but not to severe frost. Best suited for planting on higher altitudes and in higher rainfall areas. Slow growth in early youth, then more rapid in later years. A handsome tree with inverted, umbrella-like branches, not spreading. Yields an excellent softwood timber.	A. C.	15s.	1s.
Pinus halepensis	Aleppo pine	A drought-resistant pine which will grow on limestone and shale soils. Not recommended for plantations, but can be used for shelter and ornamental purposes in the drier regions.	A. C.	15s.	1s.
Pinus radiata (insignis)	Remarkable pine	A large tree of very rapid growth, producing a useful softwood. Most at home in the heavier rainfall areas. Does not like sour or poorly-drained soils. Frost-hardy but not drought-resistant, usually failing at an early age in the drier regions.	A. C.	15s.	1s.
Pinus longifolia	Chir pine	A somewhat slow-growing pine, but useful to plant in localities where the climate and soil are doubtful at the higher elevations. For timber and ornamental purposes. Not frost-resistant or very drought-hardy.	A. C.	15s.	1s.

Botanical Name.	Common Name.	Remarks.	Price of trans-plants.	Price of seed. Lb.	Oz.
Populus alba	White poplar	A rapid-growing poplar, requiring a good, deep soil in close proximity to running water. Propagated by suckers. Deciduous.	Suckers at 9s. per 100		
Populus deltoidea, var. missouriensis	Carolina poplar...	A very fast-growing poplar, producing a very good timber for matches, etc. Requires a rich, moist, alluvial soil. Moderately frost-hardy. Does not like stagnant water.	E.		
Salix babylonica	Weeping willow	A useful timber and ornamental tree, requiring a moist, well-drained soil which is occasionally flooded. Not suited for ground in which water is stagnant.	C.		
		Ornamental Trees, Shrubs and Hedge Plants.			
Abelia floribunda	—	A shrub with myrtle-like leaves, evergreen if watered. Pink-white flowers in profusion. Is used for hedges in Natal.	E.		
Aberia caffra	Kei apple	A rough, thorny, impenetrable shrub, making a good hedge. Withstands frost and drought well. Suited for all but the driest areas of the Colony. More useful than ornamental. Slow growing.	E.		
Acacia Baileyana	Silver wattle	A small ornamental tree with blue foliage and yellow flowers.	E.		
Acalypha marginata ...	—	Margin of leaf crimson; a shrub; will grow to 10 feet in height, or clipped to shape. Very useful to give colour to shrubbery.	E.		
Acrocarpus fraxinifolius	—	A small tree up to 25 feet in height; attractive foliage.	E.		
Agapanthus umbelatus	Cape Lily	Blue and white varieties.	E.		
Aleurites fordii...	Tung oil	An important oil-bearing tree from China. 25 to 30 feet in height.	E.		
Aloysia citriodora... ...	Lemon-scented verbena	A small shrub with a strongly lemon-scented foliage. Hardy, vigorous, quick-growing.	E.		

Alstonia scholaris... ...	—	A white flowered shrub, 6 feet high, similar to Oleander.	E.	
Anona reticulata	Custard Apple	Small deciduous bush up to 10 feet high, bearing the well known custard apple.	E.	
Bauhinia galpini	Pride of de Kaap	A rambling shrub, bearing orange-red flowers. Hardy.	E.	... pkt. 1s.
Bauhinia acuminata ...	Bauhinia	A large, indigenous shrub, flowering profusely in early spring. White flowers. Hardy.	E.	... pkt. 1s.
Bauhinia purpurea ..	Bauhinia	Similar to the Bauhinia acuminata, but with mauve flowers. Hardy.	E.	... pkt. 1s.
Bolusanthus speciosus	Rhodesian tree wistaria	An indigenous, deciduous tree with blue flowers at the end of long stalks. Ornamental.	E.	
Brugmansia Knightii	Moonflower	A flowering shrub with large, drooping, white flowers. Strong scent (of lily). Fairly frost-hardy.	E.	
Brunfelsia eximia... ..	Yesterday, to-day and to-morrow	Shrub 4 to 6 feet. Flowers change colour from purple to white as they grow older.	1s. each	
Buddleia sp.	Blue buddleia	A medium-sized shrub with sweet-scented blue flowers. Useful as a hedge. Rapid-growing, but frost-tender.	E.	
Buddleia sp.	Yellow buddleia	A rank-growing, yellow-flowering shrub. Useful as a hedge. Rapid-growing. Frost-tender.	E.	
Callistemon speciosus	Bottlebrush	A scarlet-flowering shrub of drooping habit. Makes an excellent hedge if trimmed along the top only.	A.C.E.	... 2s.
Carica papaya	Pawpaw	A small tree with a large, dark green foliage, bearing large edible fruits.	E.	pkt. 1s.
Casimiroa edulis	Mexican apple	A large, rapid-growing tree, 30-40 feet in height, evergreen, and bears a delicious fruit. A fine shade tree.	E.	
Cassia capensis...	Cape laburnum...	A rapid-growing shrub, bearing masses of bright yellow flowers.	E.	
Cestrum aurantiacum	Ink berry	A small shrub, bearing orange flowers in profusion.	E.	
Castanospermum Australe	Australian chestnut ...	A very fine shade tree similar in growth to Cedrela but with shiny evergreen leaves and pretty flowers.	2s. 6d. each.	

Botanical Name.	Common Name.	Remarks.	Price of trans-plants.	Price of seed. Lb.	Price of seed. Oz.
Crataegus oxyacantha	Hawthorn	Fruits yellow. Deciduous shrub. The yellow berries hang throughout the winter.	E.		
Crataegus pyracantha	Hawthorn	Berries scarlet. Shrub evergreen if watered throughout the winter.	E.		
Croton sylvaticus	Mount Selinda linden	A large-leaved, deciduous tree from Melsetter.	E.		
Cyphomandra betacea	Tree tomato	The well-known tree tomato. Will grow anywhere where Paw Paws will thrive.	E.		
Dahlia imperialis	Tree dahlia	A medium-sized shrub, making a handsome show with its single white blooms.	E.	...	pkt. 1s.
Dalbergia sissoo	Sissoo	A large deciduous tree from India, producing an excellent timber. Desires a deep, porous, well-drained soil in close proximity to running water. Will not tolerate stiff clay. Frost-hardy, but not very drought-resistant. Rapid-growing.	E.		
Datura arborea...	Tree potato	A large shrubby tree, up to 30 feet in height, with large purple flowers. Very quick grower. Fruit poisonous.	E.		
Deutzia crenata	Bridal wreath	A small deciduous shrub with double white flowers, tinged slightly pink, on long, drooping stalks.	E.		
Dombeya sp.	—	A small shrub 6 feet high, pink flowers.	E.		
Duranta plumieri	Tree forget-me-not... ...	A medium-sized, deciduous shrub with blue flowers. Useful as a hedge. Very hardy.	E.		
Eranthemum sp.	—	A shrubby herbaceous plant covered with intense blue flowers in the autumn, likes shade, evergreen, 3 feet high.	E.		
Eugenia braziliensis ...	Brazilian cherry	A small shrub, bearing orange-coloured, edible fruits. A useful hedge plant.	E.		

Euphorbia splendens ...	Christ thorn...	A small thorny shrub with bright scarlet flowers. Suitable for low hedges and borders.	E.
Freylinia Tropica	Inyanga hedge plant ...	A useful hedge shrub. Indigenous.	E.
Gardenia florida	Katjepeering	A compact, evergreen shrub with dark green, glossy leaves and pure white, sweetly-scented double flowers.	E.
Hamelia patens...	—	A compact shrub 8 feet to 10 feet in height, flower orange-yellow tubes, a showy shrub.	E.
Heliotropium peruvianum	Heliotrope	A small shrub with sweet-scented lilac or nearly white flowers. Suitable in flower border.	E.
Hibiscus rosa-sinensis	Chinese rose	Evergreen shrub with numerous scarlet flowers. Double and single varieties.	E.
Holmskioldia sanguinea	Holmskioldia	A fairly hardy shrub, bearing a profusion of brick-red flowers in large bunches. Suitable for hedges.	E.
Holmskioldia sp.	Holmskioldia	A yellow-flowering, handsome shrub similar to Holmskioldia sanguinea.	E.
Hydrangea japonica ...	—	A well-known shrub. The flowers are naturally pink, and are changed to blue by feeding the plants with small quantities of Nitrate of Soda, as they grow.	E.
Hypericum lanceolatum	St. John's wort	A small, yellow-flowering shrub. Multitudes of flowers.	E.
Iochroma tubulosa ...	Iochroma	A shrub with dark blue flowers.	E.
Lagerstroemia indaca ..	Pride of India	A large ornamental shrub, with mauve and pink flowering varieties. Handsome and hardy.	E.
Ligustrum lucidum ...	Chinese privet	An excellent hedge plant or ornamental shrub. Can be clipped into shape. Liable to die off in patches or lose its lower leaves unless planted in moist soil of fair depth. Propagated from cuttings.	A.C.
Lagunaria Patersonii ...	—	An evergreen tree with pink flowers, 30 feet high.	E.
Mangifera Indica	Mango	The well known fruit tree.	1s. to 2s. 6d. each.
Melia azedarach	Syringa	A deciduous tree, producing a good light timber. Shallow rooting. Withstands drought well. Has fine lilac flowers and persistent yellow berries. Suitable for better rainfall areas and deep sandy soil. but will grow under severe conditions.	E.

Botanical Name.	Common Name.	Remarks.	Price of transplants.	Price of seed. Lb.	Oz.
Morus sp.	Mulberry	A very large fruited variety.	E.		
Moschosma	Rhodesia spirea...	A medium-sized, blue-flowering shrub.	E.		
Nerium oleander	Ceylon rose	The Oleander. Salmon-pink, also a white variety.	E.		
Parkinsonia aculeata ...	Jerusalem thorn	A light foliaged tree, up to 20 feet high, with little yellow flowers, very beautiful as isolated specimen on a lawn.	E.		
Persea gratissima	Avocada pear	A shrub with an edible fruit.	2s. 6d. each		
Philadelphus Coronarius	Mock orange...	A pretty deciduous shrub, large scented white flowers in early spring.	E.		
Photinia japonica	Loquat...	A small evergreen tree with large leaves, bearing yellow edible fruit.	E.		
Phytolacca dioica	Belhambra	A rapid-growing, deciduous tree. Useful for ornament. Timber of no value, but seeds valuable as a poultry or cattle feed.	A.	...	pkt. 1s.
Pittosporum undulatum	Camphor laurel...	An Australian evergreen shrub, making an excellent hedge, with shining, green, scented leaves and scented berries.	9s. per 100 Class A.		
Plumiera rubra	Frangipani	A handsome shrub with pinkish red flowers. Rather delicate.	2s. 6d. each		
Plumiera occulata	—	Similar to Plumiera Rubra with white flowers.	2s. 6d. each		
Poinciana gillessii	Bird of Paradise flower	A shrub grown to 10 feet in height, thorny, flowers in clusters, orang-gold and red.	E.		
Poinciana regia	Flamboyant	A handsome red flowering, feathery foliaged tree.	E.		
Poinsettia pulcherrima	Poinsettia	A shrub with small yellow flowers surrounded by many large, scarlet, leaf-like bracts. Very showy. Double and single varieties. Also pink variety.	E.		
Poinsettia albida	Poinsettia	As above, but with yellowish white bracts. Double and single varieties.	E.		
Psidium pomiferum ...	Guava	A small, hardy, evergreen tree, bearing edible, yellow fruit.	D. E.		

Punica granatum … …	Pomegranate … … …	A shrub or small tree, having shining leaves, large scarlet flowers and large red fruit. Makes a useful hedge when well cut regularly.	E.		
Rhus lancea… … … …	Karreeboom… … … …	A small indigenous tree of graceful appearance, yielding a very durable wood. Useful for ornamental purposes. Forms a fine hedge.	A.	10s.	9d.
Roses (bush)… … … …	—	An assortment of roses of about fifteen kinds, Teas, Hybrid Teas and Hybrid perpetuals, are usually on hand at 1s. each. These roses are struck from cuttings, but are not named.	E.		
Russelia juncea… … …	Coral fuchsia … … …	A pretty red-flowered shrubby plant about 6 feet high.	E.		
Salvia involucra … …	Salvia … … … … … …	Shrubby herbaceous perennial, growing to six feet in height. Red flowers. Very suitable for cutting.	E.		
Spathodea campanulata	African flame tree… …	A handsome, heavy-foliaged tree, bearing bright red flowers. Suited for the heavier rainfall areas on deep soils.	E.		
Spirea prunifolia … …	Cape May… … … … …	White flowered shrubs four feet in height, in single and double varieties.	E.		
Streptosolon Jamesonii	Streptosolon… … … …	A shrub with orange-coloured flowers in dense masses and pale green foliage. Very frost-tender and delicate.	E.		
Tecoma Smithii … …	Tecoma … … … … …	An upright, medium-sized shrub with tubular, bright yellow flowers. Forms a useful hedge. Fairly drought-resistant.	A. E.	…	pkt. 1s.
Tecomaria Capensis …	Kaffir Honeysuckle …	A pretty trailing shrub from the Cape, with orange flowers.	E.		
Thevetia neriifolia… …	Thevetia … … … … …	An evergreen shrub, bearing bell-shaped, yellow flowers. Hardy.	E.		
Thuya orientalis … …	Thuya … … … … …	A very hardy conifer that withstands heat, cold and drought, and does not mind heavy soils. Slow-growing. Of small size. Very good for hedges.	A.C.	…	pkt. 1s.

Botanical Name.	Common Name.	Remarks.	Plants each.
Trichelia emetica	Natal Mahogany	A fine shade tree, evergreen, slow in growth, height to 30 feet, spread up to 50 feet.	1s. 6d. to 2s.6d.
Zithryllum sp.	—	A deciduous shrub up to 15 feet in height, grown for its lovely leaves, which become highly coloured in autumn.	E.
		Climbers and Creepers.	
Ampelopsis veitchii ...	Virginia creeper	Too well known to need description.	E.
Antigonon leptopus ...	Coral Creeper	A showy climber, bright pink flowers, forms large bulbs underground. Takes two or three years to reach flowering size, after this it makes a wonderful display yearly.	E.
Aristolochia elegans ...	Dutchman's pipe	A rank-growing creeper. Heart-shaped leaves. Purplish crimson flowers, spotted yellow.	E.
Beaumontia grandiflora	Beaumontia	A large climber with heavy, glossy foliage. Large white, bellshaped flowers. Blooms profusely. Fairly frost-tender.	1s. 3d.
Bignonia venusta	Golden shower	Vigorous creeper. Rapid-growing. Bears masses of orange flowers all the year round. Very useful and hardy.	1s. 3d.
Bignonia speciosa	Bignonia	A rapid-growing, showy creeper, bearing large mauve flowers. Decumbent.	E.
Bougainvillaea splendens	Bougainvillaea	Vigorous climber. May be also used as a hedge. Bracts magenta. Fairly frost-hardy.	1s. 3d.
Ficus repens...	—	A valuable climber for walls, etc., used in places where the Virginia creeper is grown, but clings to the surface much better than the latter, rather slow at first.	E.

Hedera helix...	Ivy	A dark evergreen climber. Best in shady, cool climates.	9d.
Jasminum sambac... ...	Jasmine	A vigorous, evergreen shrub climber with large trusses of fragrant, white flowers.	1s. 3d.
Jasminum primulinum	Climbing jasmine	A yellow-flowering species similar to Jasminum grandiflorum.	9d.
Lantana salviaefolia ...	—	A fine little creeping shrub with pink flowers, very suitable for rockwork, or edging borders, etc.	E.
Lonicera periclymenum	Honeysuckle (Woodbine)	Hardy climber with sweet-scented flowers, yellow inside, reddish purple outside.	9d.
Lonicera sempervirens	Red honeysuckle	Climber with red flowers. Best kept well pruned or base becomes ugly.	9d.
Mandevilla suaveolens	Mandevilla	Deciduous climber, bearing trumpet-shaped, white, fragrant flowers. Very slender.	9d.
Passiflora edulis	Granadilla	A quick-growing climber, bearing edible fruits. Subject to woolly aphis if overshaded. A good trellis plant.	E.
Podranea Brycei	Zimbabwe creeper... ...	A rank-growing indigenous creeper with large, pink flowers.	E.
Rosa bracteata...	Macartney rose...	Plant with large green foliage and numerous white single flowers. Useful as a hedge plant.	1s.
Solanum Wenlandii ...	Blue potato creeper ...	A rapid-growing creeper with tubular, blue flowers. Not frost-hardy.	E.
Wistaria chinensis... ...	—	The well-known climber with lavender coloured panicles of flowers. Purple, and blue kinds also in stock.	E.

Palms, Bamboos, etc.

Botanical Name.	Common Name.	Remarks.	Plants each.
Arundo donax	Spanish reed	A reed growing 20 feet to 25 feet in height and 1 inch thick, and very superior to the indigenous variety.	Offsets 1s. 6d. each
Bambusa fortunei	Fortune's bamboo	A small variety, 6 feet high, with canes about the thickness of a lead pencil, extremely useful for stakes in the garden.	Offsets 2s. 6d. each
Bambusa arundinacea	Whipstick bamboo	About 30 feet.	Offsets 2s. 6d. each
Bambusa sp.	Japanese striped bamboo	A very ornamental variety with golden rods marked and striped with green lines, about 20 feet.	Offsets 2s. 6d. each
Bambusa sp.	Indian variety	Similar in growth to the Bindura, with very useful rods.	Offsets 2s. 6d. each.
Chamaerops excelsa ...	Fan palm	Suitable for shrubberies, etc.	—
Cortaderia argentea ...	Pampas grass	With long white plumes about 6 feet in height; must be grown near water or close to a tap.	Seedlings 9d. each Offsets 2s. 6d. each
Cyperus papyrus	Papyrus Grass	A very handsome subject for the water garden, or planted near the drip of a tap; it does best when growing in the water.	2s. 6d. each
Oxytenanthera abyssinica	The Bindura bamboo ...	The only variety indigenous to Rhodesia, giving very useful solid rods, very tough.	Offsets 2s. 6d. each.
Phoenix reclinata	Date palm	A very hardy palm, indigenous to the Colony.	—
Phormium tenax	New Zealand flax	A useful green foliaged plant, about 4 feet high with sword-like leaves.	E.
Washingtonia robusta	Fan palm	A strong-growing fan palm.	—

Palms 2s. 6d. to 5s. each.

Offsets of Bamboos supplied during January only.

The Export of Frozen Porkers

REPORT ON FIVE CONSIGNMENTS OF PORKERS EXPORTED TO SMITHFIELD.

Division of Animal Husbandry.

Since February, 1934, five shipments of frozen porkers have been exported from this Colony to Great Britain, the fifth consignment being sold at Smithfield in September last. These consignments have included a variety of types and breeds of pigs produced under different systems of management. They were reported upon by market authorities at Smithfield and by experts in the judgment of pork. As a result a considerable amount of information is now available as to the suitability of the porkers raised in the Colony for the English market. This information, together with the comments and recommendations made in regard to these shipments, have been summarised in this article.*

1. **Number of Pigs and Prices Realised.**—The prices realised and the number of pigs exported are given in the table which follows:—

Consignment.	Date of Sale.	Number of Pigs.	Average gross price realised.
1	March, 1934	95	5.73d. per lb.
2	February, 1935	112	5.25d. per lb.
3	January, 1936...	89	5.30d. per lb.
4	September, 1936	53	5.86d. per lb.
5	September, 1937	118	6.6d. per lb.

The shipments have been too small so far to give a representative figure of the costs of export. The Manager of the Rhodesian Export and Cold Storage Company, which undertook these shipments has estimated that, if regular shipments are possible, the cost of export, including slaughter, from Bulawayo to the English market should not exceed 2d. per lb.

*Detailed reports of the third and fourth consignments have been published as Bulletin 985 and in the *Rhod. Agric. Jour.*, Jan., 1937, respectively.

Except for the first consignment, the prices given in the foregoing table average about ½d. per lb. below the prices ruling for New Zealand porkers at the time of sale. The first consignment sold for more than New Zealand pigs, but the comparatively high price realised for this shipment may have been due in part to the sentiment occasioned by the arrival of the first consignment of Rhodesian porkers on the London market. The last consignment, which sold at the highest price, was not the best but met a good market. It was not as severely graded as the previous consignments and included some pigs that were heavier and fatter than any that had been shipped previously. The report on these latter porkers is, however, of considerable value in arriving at a general estimate of the value of the ordinary run of pigs produced in this Colony for export.

2. **The General Suitability of the Pigs for Export.**—From the reports received it is clear that the better quality porkers raised in this Colony are suitable for the English market. Six different breeds or crosses of porkers were shipped, *viz.*:—

Large White x Large Black.
Large White x Middle White.
Middle White x Large Black.
Berkshire x Large Black.
Large White.
Large Black.

The best reports were received on the Large White x Large Black cross. The numbers involved are not sufficient, however, to decide definitely which is the best breed or cross for export, but as characteristic pigs of each cross were shipped and as uniformity of type is most important in this trade, for the time being it seems advisable from the information received for producers to concentrate on the Large White x Large Black cross. Good reports were also obtained on the pure Large White and the crossbred Large White x Middle White porkers, and further work with these pigs will have to be done. There was a definite discrimination shown against black pigs and against white pigs showing darkish areas on the skin, as sometime occurs in the Large White x Large Black cross.

Whilst most of the pigs were classified as good butcher's pigs, the reports are consistent that the porkers should have been longer for their weight and fuller in the hams. The question of hams is particularly stressed. There is no doubt that insufficient attention has been paid by breeders in this Colony to the development of the ham in their pigs. The difficulty of disposing of hams on the local market has led to length being stressed at the expense of ham development. This deficiency in the hams is now general and will have to be rectified if a well balanced porker is to be exported. The improvement can be made by the selection of boars and sows which show good ham development. Further, good feeding in the earlier stages of the porker's life will also help to improve the ham development.

Figure 1 shows the various types of porker carcases. The good even length and full hams of the best porker shown should be borne in mind when selecting porkers for export.

4. **Cutting Qualities of the Porkers Exported and how these Qualities may be Influenced.**—The criticism appears in all the reports that the porkers showed a deficiency of lean meat, or muscle, in relation to their weights. A number of pigs were also rather too fat or wasty.

In figure 2 is shown the cross section of a number of porkers cut through at the last rib. The good development of the eye muscle, and the comparatively small depth of fat as shown by side No. 112, should be noted as showing the required proportions of lean and fat. The worst porkers in this figure are Nos. 41 and 136, which show over-development of fat and a deficiency of lean meat. In figure 3 is shown a good streak or belly for a porker. The amount of lean meat and the even thin distribution of fat in the streak given full marks should be visualised and borne in mind.

The development of lean meat can be influenced by breeding and management and, probably, by the feeding as well. By feeding a ration high in protein, for instance, it is generally considered that the development of the lean meat is increased, though the results obtained from experiments in the past are not all consistent on this point.

The rate of development of the pigs up to weaning appears to have an important bearing on the proportion of lean meat in the body. It is important to feed for the maximum rate of growth until the pig is approximately 60 pounds in weight, because lean flesh is largely developed during the earlier stages, and as the pigs get older they put on fat instead of lean meat. Young pigs should be creep fed before weaning so as to force rapid growth and to ensure that there will be no check after weaning. Where the sow seems short of milk the litter number should be reduced so as to increase the milk available per head. An average weaning weight of 40 pounds at eight weeks should be aimed at, and it is doubtful if pigs which weigh less than 30 pound at eight weeks will make first grade porkers, even though they may look good on the hoof.

In these consignments it was found that, under conditions where the feed and management were similar, there were still considerable differences in type and suitability between the litters of individual sows. Under similar conditions some sows produced litters of good type, others did not. As it is difficult to alter economically the standard pig rations now in use, this variation suggests that under our conditions greater improvement will finally be effected by breeding only from sows whose progeny showed the desired characteristics in regard to lean meat, etc., than from any serious alteration in the system of feeding and management.

Overfatness is difficult to overcome where the bulk of the ration consists of maize. It is almost impossible to tell definitely whether a pig is overfat or not until it is cut up. Some of the porkers in these consignments which looked sufficiently lean on the hoof proved to be overfat when cut up. It is thought that this tendency to overfatness can be overcome to a considerable extent by bringing the pigs on more slowly after the 60 lbs. weight is reached. More experimental work in this connection is necessary before any definite recommendations can be made. There is perhaps a danger that the fat may become rather soft if the pigs are kept back overmuch, and good judgment is needed to secure the right degree of finish.

Standard for award of Marks. Shoulders and Hams.

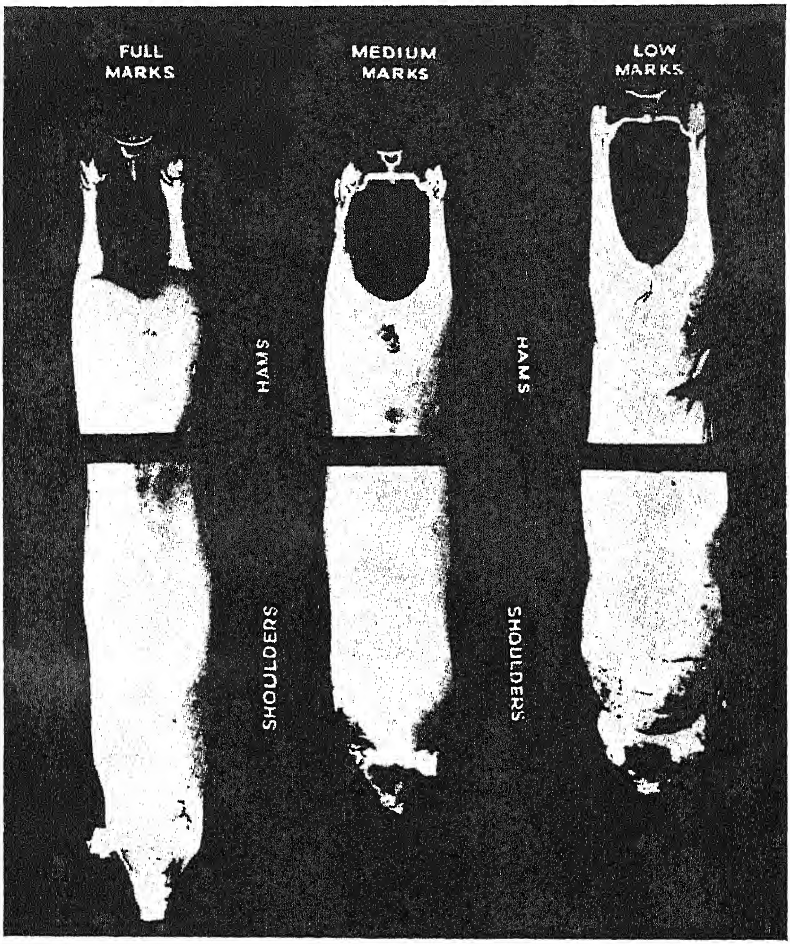

Figure 1.—Photographic scale of shoulders and hams which shows the shape for maximum, minimum and intermediate marks.

(Reprinted from "The Pig Breeders' Annual," 1936-37, from photographs by Jos. B. Swain.)

Cross section of number of porkers cut through at the last rib, showing the development of lean meat and fat.

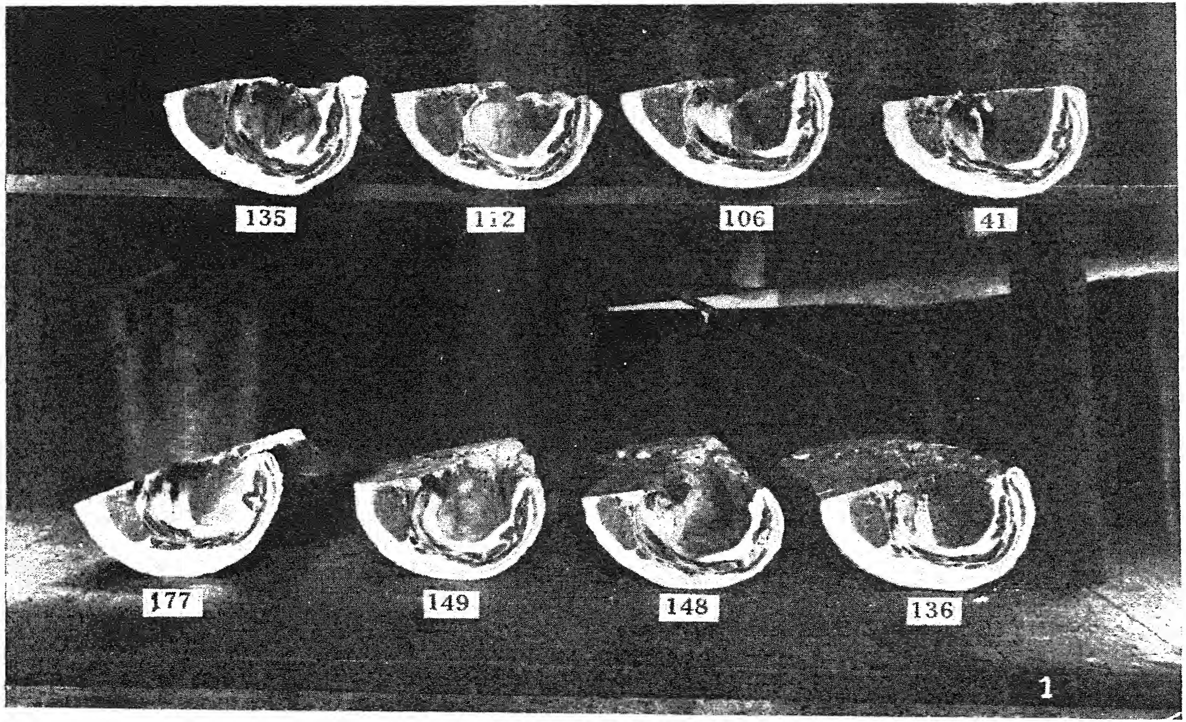

Figure 2.—Pig No. 112 shows excellent cutting qualities.

Standard for award of marks. Streak (Porker).

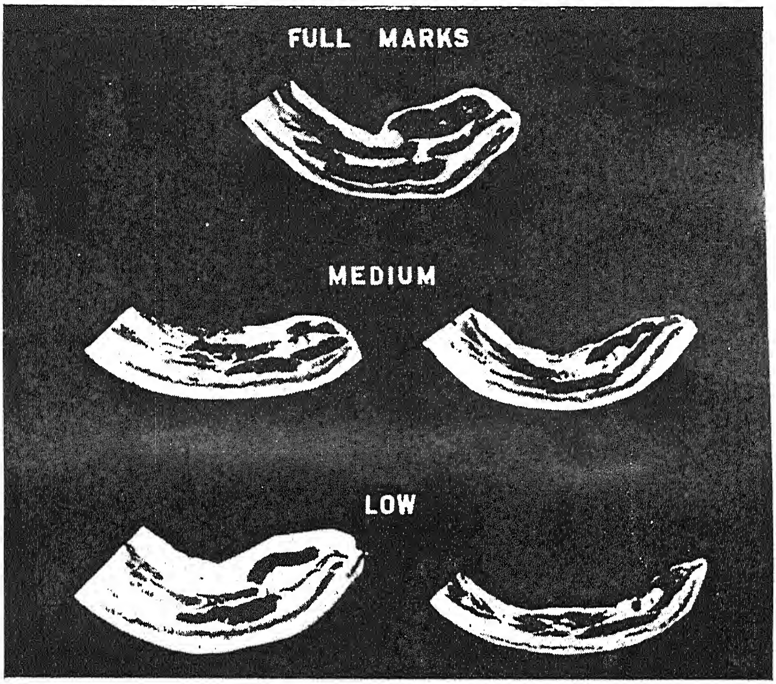

Figure 3.—Photographic scale for Streak (Porker) showing the thickness of streak and amount and proportion of lean to fat required for maximum, minimum and intermediate marks.

(Reprinted from "The Pig Breeders' Annual," 1936-37, from photographs by Jos. B. Swain.)

It is probable that by breeding from sows whose progeny are not overfat under our better systems of management permanent improvement in the cutting qualities of the progeny may be effected, and it is hoped to develop a system of litter recording in the Colony to enable farmers to select the type of breeding stock required. In such a system of litter recording the progeny of selected sows are ear-marked at birth and followed through to slaughter. An account is kept of the feed consumed and the carcases are critically examined after slaughter. In this way it is possible to select and breed from sows that are the most profilic and produce the most satisfactory porkers. In time this will raise the average productivity and type of the herd.

A few pigs were faulted for being a little soft and the rind of these carcases was said not to crisp properly on cooking. This softness was probably due in part to the excessive use of maize in the ration. This excess seems practically unavoidable under present conditions in this Colony, as any alternative concentrate to maize is comparatively expensive and, unless used in large quantities, will not overcome the influence of maize. It must be emphasised, however, that there was no general criticism of softness, though the bulk of the ration fed to all the pigs in these consignments was maize. Individuality in this connection plays a part, and the firmness of the fat can be influenced by the finish of the pig.

A well finished pig, or one that is gaining rapidly, is usually firmer than one that is not so well finished or is growing more slowly. It is possible therefore to effect improvement in the firmness of the carcases by feeding the pigs well on a correctly balanced ration. Incidentally, palm kernel cake has proved to be a valuable feed under local conditions for "firming the carcases."

4. **The Condition of the Pigs on Arrival in the United Kingdom.**—With the exception of one consignment, which was partly defrozen in transit, all the consignments arrived in good condition. The carriage of the frozen pork from this Colony to Smithfield does not seem to offer any special difficulties, except in so far as there may be difficulty at present in

getting sufficient pigs to make up regular commercial consignments. In each shipment, however, a number of the pigs showed weals and bruises on the skin, which detracted from their appearance and sale value. In one shipment some white pigs were criticised for sun scald.

Pigs mark very easily, and it cannot be stressed too strongly that all possible precautions should be taken to prevent the animals being struck with sticks and to avoid fighting between the pigs as much as possible en route to market.

Summary.—On the basis of the information available at present, and the experience gained in these shipments, the following general recommendations and suggestions are made to assist farmers to produce good pigs for export.

1. Select breeding stock showing good length and ham development and cull out and replace those sows which do not produce the type of porker desired.

2. Feed the young pigs so as to secure maximum growth up to weaning, and until a liveweight of approximately 60 lbs. is reached.

3. The young pigs should be given a high protein ration until approximately 60 lbs. liveweight so as to stimulate as far as possible the growth of lean tissue. The foundation of this ration should be $\frac{1}{3}$—$\frac{1}{2}$ lb. of meat meal of good quality (or meat and bloodmeal in equal parts) or 1—1$\frac{1}{2}$ gallons separated milk per pig. $\frac{1}{3}$—$\frac{1}{2}$ lb. meat meal is roughly interchangeable with 1 gallon separated milk.

If the young pigs receive this nucleus of protein the rest of the concentrate ration can be made up of any single farm grown grain, such as maize, nyouti, kaffir corn, etc., or a combination of these grains or a mixture of one or more of these grains with some other feed such as pollard or cowpeas. The full quantity of meat meal or separated milk may be fed as soon as the pigs will take it, after that it is not necessary to increase them and further increases in the amount of the ration should be made by increasing the quantity of maize, nyouti, etc.

4. The desired rates of growth from the weaner to the porker stage can usually be obtained by feeding the following quantities of concentrates per pig per day:—

Age.	Concentrates.	Liveweight (approximate).
8—9 weeks	$1\frac{1}{2}$ lbs.	30-40 lbs.
12—13 weeks	$2\frac{1}{2}$ lbs.	60 lbs.
16—17 weeks	3 lbs.	100 lbs.

A palatable succulent feed such as pumpkins or sweet potatoes can be used to replace part of the grain ration after the pigs weigh 60 lbs. and so lower costs of production where grain is comparatively expensive. It is not advisable to feed bulky feeds in quantities before this weight. After the porkers reach 60 lbs. the grain ration should usually be increased very gradually to prevent the pigs from getting overfat.

5. Avoid all feeds such as ground nuts, ground nut cake, sunflowers, etc., which cause soft fat.

Acknowledgements.—This Department would like again to acknowledge the help which was received from the farmers who supplied pigs for these consignments, the Rhodesian Export and Cold Storage Company which undertook the preparation and export of these shipments, and the authorities in England, who co-operated in reporting on the porkers at Smithfield.

Report of the Agriculturist

FOR THE YEAR ENDING 31st DECEMBER, 1936.

By D. E. McLoughlin, Agriculturist.

Season and Crops.—The early part of the season proved a difficult one for farmers. Few and isolated showers only were recorded in November, and the early preparation of the lands for dry planting and check rowing by hand was considerably delayed. The December rainfall was of a very local character, and whereas some farmers in the main maize belt experienced suitable planting rains a big proportion of maize growers were unable to commence planting until late in that month, while in the Midlands, Fort Victoria and Matabeleland areas droughty conditions prevailed. At this stage it was feared that the crop would be much below normal, as the bulk of the crop would require to be grown on a falling temperature. Conditions became more favourable during January, and by February crops had made a remarkable recovery. Favourable conditions were experienced in most parts of the Colony during the next two months, and aided by late rains, the maize crop provided a very substantial surplus for export. A very pleasing feature of the year was that farmers realised a good price for their surplus maize on overseas markets; the surplus synchronised with a marked improvement in the maize market, and higher overseas prices than last year. Early export was delayed on account of the late rains and the consequent high moisture content of the grain. No difficulty, however, was experienced in shipping the surplus crop before the commencement of the 1936-37 rainy season.

Maize.—The 1935/36 European maize crop was a record one and the largest Southern Rhodesia has yet attained. The total maize acreage planted was 266,513 acres as compared with 266,426 in 1934-35. Total production was 1,985,848

bags, or 7.45 bags per acre as against 1,269,185 bags, or 4.76 bags per acre in the previous year. The previous highest yield was 1,917,262 bags, or 6.04 bags per acre, obtained in 1929-30.

The Mazoe district produced 653,087 bags, or 9.2 bags per acre; Salisbury 447,996 bags, or 8.7 bags per acre; Lomagundi, 253,658 bags, or 8 bags per acre; and Hartley, 225,367 bags, or 8.6 bags per acre.

Ground Nuts.—The acreage planted to ground nuts decreased from 6,609 to 5,522 acres. In the previous year the acreage dropped from 7,109 to 6,609 acres. The season's production was 49,664 bags, or 9 bags of 65 lbs. each per acre. The output was insufficient to meet local requirements. The decline in the production of ground nuts is attributed by farmers to the low prices paid locally for this commodity. The fact, however, is that local prices are linked with overseas prices, and that the prices ruling overseas for ground nuts have rendered the export of this crop unprofitable during the past year or two. Compared with maize the average yield per acre of ground nuts is unduly low, and represents only about 50 per cent. of what should be attained under our conditions of climate and soil. It is evident that the ground nut is not receiving as good treatment as its profit returning capabilities warrant.

During the year the standard weight for a bag of ground nuts in shell was altered to 65 lbs. nett per bag.

Green-manuring.—Crops grown for green-manuring show an increase of 5,883 acres, the figures being 53,995 acres in 1935-36, and 48,112 acres in 1934-35. Sunnhemp is still the most popular green crop, and 32,006 acres were planted to it; sunflower accounted for 12,306 of the total acreage, the balance being made up by bean crops and trap crops for witchweed. The Government Statistician reports that the practice of sowing a mixture of half and half sunnhemp and sunflower is increasing in popularity.

Wheat.—The wheat season of 1936 was a difficult one for farmers operating on vlei land, and in the majority of cases

low yields were recorded. The industry is making satisfactory progress and the acreage under wheat increased by nearly 3,000 acres in 1936. The total crop was 58,099 bags from 22,282 acres, or 2.61 bags per acre.

Vlei land wheat suffered badly from frost and rust and irrigated wheat mainly from rust. The early part of the season promised well and there was a tendency on the part of some vlei land growers to seed too early in April. Severe injury to the wheat crop was caused by a late frost in September. With the improved methods of cultivation adopted by farmers and the distribution by the Department of better varieties and strains of wheat it is reasonable to forecast that within the next few years production should go a long way towards meeting the full requirements of the Colony.

A draft constitution for the formation of a Southern Rhodesia Seed Wheat Association was prepared by the Agricultural Branch, and its inauguration will further assist the industry by providing more suitable and reliable seed to farmers.

The importance of maintaining the humus content of wheat soils, particularly the sandy wet vlei types, continues to be strongly emphasised by this Branch, and three articles have been published in the *Rhodesia Agricultural Journal* during the year describing two methods, new to this country, of largely increasing the supplies of organic manure on the farm; firstly, by the latest methods designed at Indore in India for the making of rain watered compost, and secondly, by growing sunnhemp for cutting and placing in the cattle kraals in order to increase the output and quality of the kraal manure. A large number of farmers are testing the former, and it has been employed most successfully by the Royal Salisbury Golf Club for 18 months. The latter method has been used with great success by one farmer.

International Test of Geographical Types of Lucerne.—The results obtained in this trial in the year 1935 were published in the journal "Imperial Bureau of Plant Genetics:

Herbage Plants. Memorandum No. 6, November, 1935." After the summer rains ceased in March, 1935, irrigation by hand was continued until the cutting of the crop in June of that year, when it was discontinued. Since this date no artificial water supply has been given. By the commencement of the 1935-36 rainy season in November many of the plants in the different plots had succumbed to drought and no useful comparison could therefore be made of the fodder yields in 1936.

On the 11th December, 1936, a count of all plants which had survived the dry season was taken and the result is shown in the tabulation below.

Of the surviving plants those of the Cape Provence variety made the best growth, attaining a height of 15 inches. The other varieties made little or no growth. These results confirm those of previous trials, *i.e.*, that on red soils of the type met with on the Salisbury Experiment Station lucerne will not thrive under summer rainfall conditions as a perennial crop and that irrigation is essential for its successful cultivation.

Analysis of Survivors. 11th December, 1936.

Types.	Block Numbers. 1	2	3	4	5	Av. per line.	% Survivals.
Khivian	0	3	6	1	1	2.2	4.5%
Semiryechensk	2	5	4	6	1	3.6	7 1-5th%
Turkmen (2528) ...	8	11	16	16	17	13.6	27.5%
Turkestan (2578) ...	4	7	4	9	1	5	10%
Asia Minor (3189) ...	14	8	14	17	5	11.6	23%
Hungarian	13	17	9	12	12	10.6	21%
Provence...	7	14	14	18	12	13	26%
Grimm	8	14	8	9	4	8.6	17 1-5th%
Cape Provence	30	24	19	32	13	23.6	47 1-5th%

The trials were concluded by the removal of the roots on the 11th December, 1936.

Vlei-land Pasture Demonstration Station, Rusape.—Work on this station commenced during the year. A site for this co-operative demonstration station was selected on a piece of

Government land adjoining the farm Cornucopia. It is situated on the main Salisbury-Umtali road, about two miles distant from Rusape at the railway crossing. The Station is operated with the co-operation of the Rusape Farmers' Association and by a committee of four of it members appointed annually and under the management and direction of the Agriculturist. The work on the Station is carried out by members of the committee and a sum of £100 is provided by the Government on the estimates of this Department for the purchase of fertilisers, seeds, fencing, etc.

The direct interest of farmers, and their personal experiences gained on this Station, should prove most valuable in disseminating the results and assist in convincing farmers of the value of vlei pastures. Further, it is hoped that this will result in the establishment of permanent pastures on thousands of acres of waste vlei land at present subjected annually to burning as a means of providing early grazing for only a few weeks in the year. This practice is responsible for the destruction of the natural cover of the main water sources of the Colony, and the resulting widespread erosion.

The advent of the seasonal rains is welcomed by all livestock farmers and dairy farmers as a means of producing cheap beef and milk. The work on this Station is designed on lines which will strongly appeal to dairy farmers situated on granite soils and possessing numerous undeveloped wet vleis, which are capable of producing succulent grazing throughout the year.

The conversion of waste vlei land, the Colony's most valuable asset to improved permanent pastures, would enable our farmers to compete more successfully with other Dominions in the export of dairy produce and beef and ensure a continuity of supply to overseas markets all the year round. The deficiency of legumes in our natural pastures, and the difficulty of providing these as a constituent of dry land pastures under local climatic conditions, further increases the value and importance of wet granite vlei soils, since these are capable of producing clover during the winter and dry months —in the absence of a winter rainfall—under proper management.

The trials on this Station will include:—

(1) To test the suitability of and carrying capacity and milk production of indigenous and exotic wet land grasses:—

(*a*) in pure stands plus clovers;

(*b*) mixed grasses plus clovers.

(2) To ascertain the effect of artificial fertilisers:—

(*a*) on economical yields of grazing and milk production;

(*b*) the result of applying the fertilisers on the persistency of clovers.

(3) To ascertain the effect of draining and judicious cultivation of established vlei pastures.

The plots will be situated on wet granite vlei land and will be two acres in size. Each two acre plot will be completely fenced and provided with a small gate.

Commencing 1938 all plots, excepting miscellaneous introductions, will be systemtaically grazed in rotation by tested cows. Grazing days and milk yields obtained on each plot will be recorded and monthly returns submitted to the Agriculturist, together with all cultural operations done during any one month.

Dry Land Pasture Grass Investigations.—A progress report summarising the investigations carried out by the Agricultural Branch over the past sixteen years, with the main object of ascertaining the most suitable of the indigenous and exotic grasses for use in laying down pastures in this Colony, was published in the April, 1935, issue of the *Rhodesia Agricultural Journal.*

Investigations regarding the stock carrying capacity on normal, red, maize soil of a number of the most promising grasses which have been established as pure stands in small paddocks was continued. During the year two recent introductions, *i.e.*, Kafue Rhodes (*Chloris gayana*) and Peddie strain Woolly Finger (*Digitaria sp.*) were included in the grazing test and established in separate paddocks.

The tabulation given below shows the number of grazing days for a single ox which one acre of each of the grasses listed has provided since the season 1931-32.

The yields from the pasture grass trial paddocks in 1935-36 were somewhat less than the average for previous years. This was largely due to the lack of rain during the early part of the season. The rainfall during the period October 1st, 1935, to January 31st, 1936, was less than half of that of the same period of the previous season and was considerably lower than the precipitations recorded for the corresponding periods during any season since these experiments were started.

PASTURE GRASS TRIALS.

Grazing Days for a Single Ox.

Season.	Woolly Finger.	Hunyani.	Creeping False Paspalum.	Reed Timothy.	Mixed Creeping Grasses.
1931-32	316	307	—	—	—
1932-33	192	198	204	319	—
1933-34	238	238	385	243	251
1934-35	319	216	180	319	354
1935-36	194	197	243	248	134
Averages ...	252	231	253	282	246

These returns show that, in spite of the unfavourable climatic conditions which prevailed at the beginning of the season, each acre of grass provided from 7 to 8 months' grazing for a single ox. These trials have demonstrated, therefore, that the carrying capacity of these pastures is much greater than that of the natural veld, and serve to show that by growing suitable types of grass on fertile soil, pastures comparable with those of other countries can be produced in this Colony.

Lawn Grasses.—Various species of coarse and fine couch (*Cynodon spp.*) have been under trial for a number of years, both at the Station and in co-operation with golf clubs, sports clubs, and private persons, and a considerable body of experience has been gained. Finality has not been reached, and it is very improbable that it ever will be, since new strains of both coarse and fine couches are continually being brought

to notice, but it is considered that the following brief notes may assist the public in choosing a type of grass reasonably suitable for any particular purpose.

Common Couch or Bermuda Couch.—There are many strains of this grass, all apparently identical botanically, but differing considerably in habit of growth, colour, and drought resistance. Most of these strains make good rough lawns, but it is difficult to maintain most of them in a condition pleasing to the eye, without frequent expensive top-dressing.

Generally speaking the light blue, non-hairy strains are most drought-resistant.

The strain, imported originally from Australia, and known locally as "Australian Couch," is a much more rapid grower than local strains, and has a deeper, more pleasing, dark green colour. It is not so drought resistant as local strains, but makes a much more handsome lawn, and is probably the best type to use for ordinary lawns.

Bermuda Couch generally is free from damage by white ant, except the Harvester Ant. It is fairly resistant to frost.

Magennis Grass.—Of the fine couches this has so far proved most satisfactory for fine lawns, golf and bowling greens. When properly looked after it has a handsome dark green well-groomed appearance, and with correct treatment will yield either a soft springy lawn, or a firm surface for putting or bowls. Magennis is not very drought resistant, and requires watering in the longer dry spells during summer to keep it in good order.

It is susceptible to frost, but in this Colony seems to be free from "nap" when kept well cut down on a firm soil surface.

Elgin Upright.—This grass, introduced originally by this Department from the Cape by the courtesy of Dr. Murray, of Cape Town, is finer than Magennis, but similar in appearance, though having an even darker and more pleasing green colour.

It has been insufficiently tested to report fully on its drought resistance and other characteristics, but it is thought that it may need rather more attention than Magennis. It is resistant to drought and frost, and quite free from "nap."

For anyone who can water freely and can give it good treatment this grass will make the finest quality of lawn turf, and the most pleasing to the eye of any grass so far tested. A lawn of this grass is, it is considered, equal or superior in appearance to any grass grown anywhere in the world.

It is being tested as a putting green by the Royal Salisbury Golf Club, and more information concerning its value for this purpose will be available in another twelve months. It should prove ideal for bowling greens.

Harrismith Grass.—This grass has proved very unsatisfactory for greens on the Royal Salisbury Golf Club's course, being very difficult to keep under control, that is to say, cut to a firm putting surface, except for a few months prior to the rainy season. It is also very attractive to several species of very destructive white ants and suffers from an objectionable "nap." To keep it under control it must be starved, and it then becomes very weak and patchy and lets in weeds. If dried off during winter it recovers slowly and unevenly. It is susceptible to frost, and has an unpleasant yellow colour, unless generously fed with nitrogen. It cannot be recommended for any sporting purpose.

Karroo Grass.—This grass was introduced by this Department from Cape Town by the courtesy of Dr. Murray. It is very similar in appearance to Harrismith grass, though finer. It appears to be fairly drought resistant and is said to be free from "nap." Experience of it is insufficient, but at present it appears to offer no particular qualities for lawns or sports turf.

Royal Cape.—This grass was introduced by this Department through the courtesy of Dr. Murray from the Royal Cape Golf Course. It is itermediate between Bermuda, and Magennis in fineness, though nearer to Bermuda, perhaps in this respect. It is a lighter colour green than Magennis.

It has been tested out extensively as a lawn grass over the past five or six years, and has proved very satisfactory, being drought resistant, and quite frost resistant, as far as experience here goes. It is also reported to be frost resistant in Cape Town and Johannesburg. It appears to be very disease resistant, being much less affected by two diseases, which have attacked the Magennis grass this year on the Royal Salisbury golf course.

One green on this course was laid down to this grass last season (in December, 1936) and was in excellent condition for play within less than three months from planting (84 days). It has proved much more satisfactory over the period of one year than Magennis, which was planted at the same time on other greens, and had identically the same treatment. During the winter it made much better use of the limited water supply, and was completely unaffected by drought or frost, whereas Magennis grass was severely affected by both.

For golf greens it would appear to require less generous treatment in the way of top-dressing and fertilising than Magennis. With generous treatment it tends to grow too freely, and become rather slow for good putting in the summer. During the winter from April to October it yielded excellent and fast putting.

A great feature of this grass is that it is easily cut to a fine surface without "scalping," and this is a big advantage in a country where the labour is unskilled, and the mowers can seldom, if ever, be kept in proper order.

During September and October it flowered profusely, and as the flowering stems are very stiff frequent cutting was necessary to maintain a good putting surface.

This grass can be strongly recommended for lawns and putting greens, but so far no experience of it on bowling greens is available.

It is considered to be much superior to Magennis grass for golf greens during eight months of the year, and its equal for the remaining four months.

Seed and Plant Introduction and Distribution.—The introduction of new crops and new varieties of old crops from foreign sources and the subsequent distribution of these, together with selected new strains and new hybrids bred on its Station is an important service of the Agricultural Branch to Rhodesian agriculture, as it provides information at small cost to the farmers of the Colony on the economic value of many kinds and varieties of crops which are frequently given much publicity elsewhere. Occasionally new introductions turn out to be extremely valuable, but more often they have

no value under conditions obtaining on these stations. Thus, large savings are made for farmers served by these stations each year by the information provided by the Branch through the timely study of new plant introductions.

During the four years 1933 to 1936 inclusive new introductions on the Salisbury Experiment Station totalled 355 and free issues of seed, grass root, and planting material, etc., were as follows:—

To farmers in the Colony	1,626
To Government Institutions in the Colony...	324
To Institutions and Stations in other countries	291

The above figures do not include introductions and issues of wheat and other cereals made by the Plant Breeder.

(To be continued.)

Southern Rhodesia Weather Bureau.

OCTOBER, 1937.

Pressure.— Mean barometric pressure was slightly below normal in the south and east and about normal in the north.

Temperature.—Mean temperature was slightly below normal over the whole country, the lowest temperatures occurring in the east, where temperature varied from 1.5 to 2.0° below normal.

Rainfall.—Very little rain was recorded.

AIR MOVEMENTS DURING OCTOBER.

The Indian Ocean Trade Winds were well developed over the north of Madagascar during most of the month, and the predominant N.E. winds over Southern Rhodesia were derived from this source. The weather associated with them was fine and warm. A few light thunder showers occurred when an upper current from between S. and S.W. produced unstable conditions. With the passage of southerly lows the surface wind swung towards the north, and weather became warmer.

Maritime Air brought cool cloudy weather to the south and east on the 1st, 2nd, 6th, 10th, 11th, 12th, 21st and 28th. The north of the country was only affected on the 2nd, 11th, 12th and 22nd.

Cold Southerly Air only invaded the country once during the month, on the 22nd. It moved northwards as far as Salisbury, and was followed by a period of trade winds from the Indian Ocean to the south of Madagascar. This period lasted until the 27th, and the weather was characterised by cool nights and warm days.

A peculiar situation occurred on the 11th. A low had just moved up the Mozambique Channel, and a rush of cool maritime air in its rear formed a local high over the Eastern Border, where thunderstorms and rain were reported at 8.30 a.m. The high spread out during the day giving strong winds over the rest of the country.

PRECIPITATION.

Station.	Inches.	Normal.	No of days.
Beitbridge	1.60	0.85	1
Bindura	0.13	0.59	1
Bulawayo	0.09	0.74	2
Chipinga	1.31	4.33	6
Enkeldoorn	0.11	1.05	2
Fort Victoria...	0.75	0.90	3
Gwaai Siding...	0.25	0.41	2
Gwanda	0.10	0.79	1
Gwelo	0.07	0.67	2
Hartley	0.11	1.03	2
Inyanga	0.02	1.12	1
Miami	0.12	0.37	2
Mount Darwin	Nil	0.39	—
Mount Nuza	1.35	1.11	6
Mtoko	Nil	0.62	—
New Year's Gift	0.92	0.92	4
Nuanetsi	2.21	0.93	2
Plumtree	0.52	0.74	3
Que Que	0.11	0.73	4
Rusape...	0.01	0.76	1
Salisbury	0.07	1.10	2
Shabani	0.52	0.67	1
Sinoia	0.24	0.83	1
Sipolilo	Nil	0.48	—
Stapleford	0.73	1.78	5
Umtali	0.44	1.08	6
Victoria Falls	1.22	0.53	3
Wankie	0.46	0.36	4

OCTOBER, 1937

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	8-30 a.m. Wet Bulb.	8-30 a.m. Dew Point	8-30 a.m. Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
gus Ranch... ...	...	74.8	62.7	55	14.5	88.8	59.2	74.0	104	9th	44	24th	17	...	5	...	...	...	...	...	...	...
itbridge...	1,500	74.2	63.8	57	12.5	88.2	64.4	76.3	103	9th	49	24th	19	1	15	...	76.5	966.6	884.7	...	3.9	...
ndura...	3,700	71.8	59.7	51	13.6	85.5	62.4	73.9	97	9th	54	3rd	16	...	8	...	73.4	893.6	883.5	...	3.0	...
lawayo	4,393	70.2	57.1	47	14.0	85.4	58.7	72.1	97	9th	48	23rd	18	1	2	...	71.8	871.1	882.5	869.2	4.0	9.6
ipinga	3,685	69.1	59.1	52	11.0	78.0	55.2	66.6	93	9th	44	24th	5	3	...	...	65.9	895.0	884.5	...	4.2	...
keldoorn...	4,788	69.7	55.5	43	15.0	82.2	55.0	68.6	93	9th	45	23rd	9	1	1	...	69.0	859.4	882.8	...	2.4	...
rt Victoria	3,571	71.7	58.8	49	14.5	84.6	57.4	71.0	99	9th	48	24th	16	1	3	...	71.7	897.5	883.4	...	3.6	...
vaai Siding	3,278	76.1	61.3	51	18.0	94.5	61.7	78.1	108	17th	54	4th	28	...	4	...	...	905.8	882.5	...	2.9	...
vanda...	3,233	73.4	61.2	53	14.0	87.1	61.5	74.3	100	9th	52	22nd	18	1	5	...	78.0	907.9	883.2	...	3.4	...
velo	4,629	69.7	56.9	46	14.0	84.2	56.9	70.5	95	9th	47	23rd	16	2	3	...	70.3	864.1	882.8	...	3.0	...
rtley...	3,879	74.4	58.9	46	17.8	88.2	59.0	73.6	98	9th	51	25th	23	...	3	...	74.0	887.1	882.6	...	2.3	...
yanga...	5,503	68.8	55.5	45	14.2	78.7	52.9	65.8	90	9th	41	25th	3	3	...	...	65.3	...	...	...	2.6	...
arandellas	5,453	68.2	54.8	42	14.0	79.9	54.5	67.2	90	9th	46	24th	4	2	...	...	66.9	...	...	...	1.4	...
iami	4,090	72.3	59.5	50	14.9	84.0	60.5	72.3	94	9th	52	4th	14	...	4	...	72.3	880.2	882.3	...	1.4	...
ount Darwin ...	3,179	74.7	61.7	53	15.2	87.0	62.6	74.8	99	9th	55	25th	20	...	5	...	74.9	909.8	...	...	2.3	...
ount Nuza	6,668	57.0	50.5	43	5.8	65.9	49.2	57.5	82	9th	38	23rd	...	20	...	1	56.5	803.8	883.7	802.4	6.0	...
toko	4,141	70.2	57.8	48	13.6	80.9	59.1	70.0	92	9th	49	25th	6	...	3	...	70.2	879.7	883.4	...	2.3	..
ew Year's Gift...	2,690	72.2	62.5	55	11.6	85.1	57.3	71.2	101	9th	45	25th	14	1	...	...	...	...	...	...	...	8.8
uanetsi	1,581	73.3	64.3	59	11.0	88.7	61.4	75.1	102	9th	45	24th	21	1	9	..	...	964.7	885.3	...	...	...
umtree	4,549	72.6	57.7	45	17.0	85.1	61.5	73.3	94	9th	49	23rd	18	1	7	..	72.5	865.9	882.0	...	2.0	...
ue Que...	3,999	71.7	57.4	46	15.8	87.4	60.2	73.8	97	9th	52	23rd	22	1	6	...	73.6	883.4	882.6	...	2.5	...
usape	4,648	68.5	55.9	45	13.2	81.8	53.7	67.7	95	9th	40	25th	11	2	1	...	67.5	...	...	...	2.5	...
alisbury	4,831	70.0	56.3	45	14.8	82.9	56.8	69.9	93	9th	47	25th	10	1	3	...	69.6	858.1	882.6	856.3	2.5	9.2
nabani...	3,131	73.3	60.7	52	14.7	86.3	59.7	73.0	102	9th	51	24th	17	1	3	...	73.6	...	...	...	2.6	...
noia	3,795	74.5	60.6	51	16.6	88.6	58.4	73.5	98	9th	50	4th	22	...	1	...	74.1	890.0	...	...	2.8	...
ipolilo	3,876	73.7	59.3	48	16.6	84.5	62.8	73.7	94	9th	55	3rd	14	...	9	...	...	886.9	882.6	...	2.0	...
tapleford	5,304	61.8	55.5	51	7.3	72.0	49.0	60.5	87	9th	32	25th	1	11	...	4	60.4	844.8	884.0	...	4.1	...
mtali	3,672	68.8	59.2	52	10.5	83.7	57.7	70.7	102	9th	48	24th	14	1	1	...	69.5	895.4	884.5	893.7	4.6	8.6
ictoria Falls... ...	3,009	78.1	62.4	52	19.4	95.0	64.6	79.8	103	8th	53	4th	28	...	9	...	...	912.5	881.7	...	3.1	...
Vankie	2,567	81.7	63.8	52	25.0	96.8	70.9	83.9	105	8th	59	24th	30	...	27	...	84.6	926.8	881.5	...	2.6	...

Rainfall in October, 1937, in Hundredths of an Inch. Telegraphic Reports.

a	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total	No m
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	1	...	...	...	...	...	...	...	3	15	9	1	...	...	...	...	...	...	...	1	6	5	...	...	...	...	...	...	...	...	...	41	[illegible]8

Southern Rhodesia Veterinary Report.

SEPTEMBER, 1937.

DISEASES.

African Coast Fever.—The disease was diagnosed on the farm Hartebeeste Nek in the Melsetter native district.

TUBERCULIN TEST.

Seven bulls were tested upon importation with negative results.

MALLEIN TEST.

Twenty-five horses were tested. No reactions.

IMPORTATIONS.

From the Union of South Africa.—Horses 21, bulls 7, sheep 1,238.

From the United Kingdom.—Horses 1.

EXPORTATIONS.

To the Union of South Africa.—Oxen 515.

To Northern Rhodesia.—Oxen 300.

To Nyasaland.—Horses 3.

To Portuguese East Africa.—Cows 2.

EXPORTATIONS—MISCELLANEOUS.

To the United Kingdom in Cold Storage.—Chilled beef quarters, 7,769; frozen boned beef quarters, 5,922; frozen beef

quarters, 3,551; chilled pork, 95 carcases; kidneys, 2,308 lbs.; tongues, 12,520 lbs.; livers, 14,839 lbs.; hearts, 6,387 lbs.; tails, 1,936 lbs.; skirts, 1,256 lbs.; shanks, 12,922 lbs.

To Northern Rhodesia.—Beef, 51,000 lbs.

Meat Products.—From Liebig's Factory: Corned beef, 75,480 lbs.; beef fat, 70,764 lbs.; tongues, 1,680 lbs.; rolled beef, 210 lbs.

B. A. Myhill,
Acting Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-37.

Monthly Report No. 59. October, 1937.

Swarms of the Red Locust (*Nomadacris septemfasciata*, Serv.) have been reported from the following districts during the month, namely, Umtali, Melsetter, Victoria, Belingwe, Makoni, Marandellas, Sebungwe, Bulawayo, Charter, Ndanga, Gwelo and Hartley. Many of these swarms have been described as large.

The reports refer mostly to the eastern and southern portions of the Colony.

The number of reports received is rather less than during the same month last year, but the position appears to be very similar.

Egg-laying has not been reported and specimens received at Salisbury had not yet attained egg-laying condition.

No evidence of disease or parasites has been recorded.

Some damage to crops and early grass is reported from the eastern districts.

RUPERT W. JACK,
Chief Entomologist.

NOTICE

The Agricultural Journal of S. Rhodesia

is issued by the Department of Agriculture, and can be obtained upon application to the Editor. The Annual Subscription, which must be paid in advance, is 5/-, and payment may be made by any means other than by stamps.

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Date..........................19......

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